

ARCHITECTURAL EDITION

of

The DUNHAM HAND BOOK

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DUNHAM PRODUCTION FACILITIES



The Dunham Differential Vacuum Heating System and individual parts of the apparatus used in that system are fully protected by United States Patents Nos. 1,644,114, 1,706,401, 1,727,965, 1,761,819 and 1,771,077 and Canadian Patents Nos. 282,193, 282,194, and 282,195. Additional patents in the United States, Canada and foreign countries are now pending.

Look for the Name

DUNHAM



Trap Used on Differential Vacuum Heating Systems



Dunham Building, Chicago

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Look for the Name

DUNHAM



Trap Used on Low Pressure and Vacuum Return Line Systems

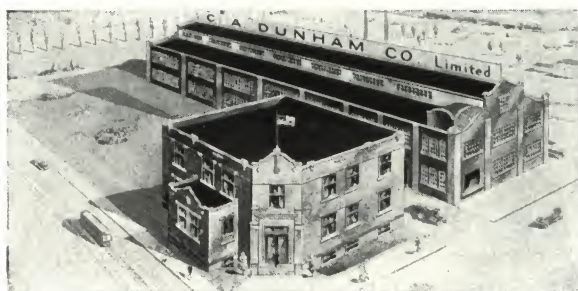
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Foreword

Throughout the quarter century from the invention of the Dunham Thermostatic Radiator Trap to the introduction of the Dunham Differential Vacuum Heating System the name DUNHAM has stood for a courageous, forward-looking progress that envisioned a greater task than mere manufacturing, and sought to serve by reason of its outstanding contributions to the science of heating.

For a quarter century those products and inventions bearing the name DUNHAM have won, and held, through their universally recognized service to the heating industry, the high esteem of architects, consulting engineers and heating contractors throughout the world.

To this world-wide prestige came in 1927 a new honor in the invention and development of the Dunham Differential Vacuum Heating System. This system of heating is even more revolutionary in its operation and in the advantages it assures than was the Dunham Thermostatic Radiator Trap which 27 years ago revolutionized an industry and made possible the use of low pressure steam which has been accepted as standard until now.

The Dunham Differential Vacuum Heating System

This system has won well nigh universal acceptance by architects, engineers and contractors, undoubtedly due in a large part to the good name borne by the products of this company. This acceptance has been more than justified in the phenomenal fuel economies which have been effected in all parts of the country and in practically all types of buildings.

To those interested in actual operating costs during past heating seasons we will gladly send such data upon request.

Important

All manuscript for this section of SWEET's 1931 edition had to be in the hands of the publishers August 1, 1930. We therefore call attention to the fact that without at all changing the principles of operation certain refinements and improved methods of installation have been made since some of the detail drawings here shown were sent to the printer. We therefore urge users of this book to secure latest detail drawings from our nearest sales office (see page 1) before laying out a Differential System.

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THE DUNHAM SYSTEMS OF HEATING

The Dunham Systems of Heating may be described in their several adaptations to different classes or types of building as follows:

- The Dunham Differential Vacuum Heating System.
- The Dunham Vacuum Return Line Heating System.
- The Dunham Return Heating System.
- The Dunham Home Heating System.

Each of these several designs is a complete two-pipe system, the great efficiency of which is made possible by the use of the Dunham Radiator Trap, which is installed at the return outlet of each radiator or pipe coil, where it stands guard against waste of steam and constantly relieves the radiation of the enemies of heating efficiency—air and water.

The Dunham Differential Vacuum Heating System

This system is a two-pipe system in which steam is supplied to the radiators at vacuums varying with the heat losses. It is so designed that a relatively constant difference in vacuum is maintained automatically between the radiators and the return piping (the vacuum in the return line being slightly higher), thereby assuring a circulation of steam to and within the radiators whenever there is demand for heat.

It is simple in its component parts, requiring practically the same equipment as a vacuum return line system with the exception that:

- (1) A properly controlled vacuum pump having capacity to create high vacuums economically must be provided.
- (2) The traps must function under vacuums as high as 25 in.
- (3) The radiator valves must be of the all metal packless type and be equipped with regulating plates of the proper size.
- (4) The temperature controlling equipment must be selected to meet the requirements of each individual installation.

The system is flexible in operation resulting in comfortable and economical warmth for the occupants of the rooms in the milder months of early Fall and Spring as well as the extreme cold months of Winter. This is accomplished by increasing the vacuum (which is synonymous with "cooler steam") during the mild weather and by lowering the vacuum or if necessary operating under slight pressure (which is synonymous with "hotter steam") during the extreme cold weather.

The average system of heating is designed with sufficient radiation to heat a building to 70 degrees when the outside temperature is at the lowest for the season. However, since the low or minimum temperature is reached or approached only a few days during the heating season the system has too much capacity during the average weather condition, and since no provision is made to vary sufficiently the temperature of the steam supplied to the radiators, the rooms are overheated.

The Dunham Differential Vacuum Heating System saves this heat waste which amounts to 25 to 50 per cent of the total fuel consumption for the heating season.

The Dunham Vacuum Return Line Heating System

The system of steam mains and piping supply all radiation, and the return piping carries away the air and water of condensation. A vacuum is mechanically

maintained in the return piping. Steam may be supplied direct from boiler plant, or through reducing valve where boiler pressure is too high (over 15 lb. gauge) for direct service, or exhaust steam may be used, supplemented by live steam through a reducing valve.

The returns all converge and grade to the suction inlet of a vacuum pump which may be either steam or motor driven. When motor driven pump is used it may also act as a boiler feed pump. Where exhaust steam is used, the discharge from the vacuum pump should go to a freely vented automatic receiver of a boiler feed pump, the vacuum pump not being used directly to feed the boiler. The system operates efficiently with steam at the lowest pressures, reducing the back pressure on engine to a minimum.

The Dunham Home Heating System

The system is simple in arrangement and design, easy and efficient in operation. It is, as its name implies, especially designed for the home or small building. It uses steam at very low pressure, not over eight ounces, for distribution of heat, which passes naturally through the steam piping and the Dunham Packless Radiator Valves into each radiator, where it is retained by the Dunham Radiator Trap until it has given off its heat, when, as water, it passes through the trap together with the air, and back to the boiler through the return piping. The air is released by the Dunham Air Eliminator, and the water returns naturally to the boiler. The Dunham Air Check on the Eliminator permits the system to produce a strong vacuum under a declining fire, thereby causing the water in the boiler to continue to vaporize on vacuum pressures, so that heat is held in the radiators for a considerable period. No troublesome air valves are used on the radiators. The end of each steam main is vented through a Dunham No. 1A Trap into the return piping, and is dripped through a wet or dry drip pipe directly back to the boiler. It is necessary that the steam pressure be automatically regulated by a sensitive damper control.

The Dunham Return Heating System

This system comprises the simplicity in arrangement and design of the Dunham Home Heating System, and it is accompanied by the same maximum efficiency. It differs from the systems already described in that it makes use of the Dunham Return Trap in addition to the Dunham Air Eliminator, which introduces the added feature of a positive automatic return of water to the boiler when it is desired to raise the steam pressure. The Dunham Condensation Pump and Receiver is used on systems with low returns.

The feature of a positive return under varying steam pressures up to 15 lb. makes this system particularly adaptable to apartment houses, small hotels and medium sized commercial buildings, schools and churches.

The check placed on the vent of system permits the system to produce a high vacuum under a declining fire, thereby causing the water in the boiler to continue to vaporize on vacuum pressures, so that heat is supplied to the radiators for a considerable period.

This system makes possible the modernizing of old one-pipe and two-pipe gravity flow systems, materially increasing their efficiency by the introduction of the Dunham Radiator Trap at each radiator, insuring positive circulation without loss of steam, and permitting the removal of all sputtering, leaking air valves which are such trouble makers in these old heating installations.

Dunham Air Line System

This is a one-pipe steam system, using a Dunham Air Line Valve on each radiator in place of the usual sputtering air valve, with a system of air line piping which may discharge the air by gravity, or be attached to an air line vacuum pump.

This system is particularly adaptable in making old one-pipe heating systems more efficient. It is easily and cheaply installed, and insures the quick removal of air from the radiators.

THE DUNHAM RESEARCH LABORATORIES

Important Data of Service to Architects in the Selection of Heating Systems

The Dunham Research Laboratories play an important part in the efficiency of design and of operation of all Dunham Appliances. Extensive tests and detailed studies of each element affecting design, performance and service conditions are constantly carried on. The Dunham Differential Vacuum Heating System principle was proved by several years operation in the experimental heating system of the laboratory before the first commercial installation was made. The results obtained in commercial installations confirmed the laboratory tests. The commercial product is also tested regularly, the laboratory tests

being in addition to the regular factory test which every trap, valve or other appliance must undergo before shipment. Raw materials are also subjected to technical inspection.

Radiator Tests

This and following pages show graphical results of radiator tests performed in our Research Laboratories (completely equipped for, and continually conducting, experiments in all phases of heating).

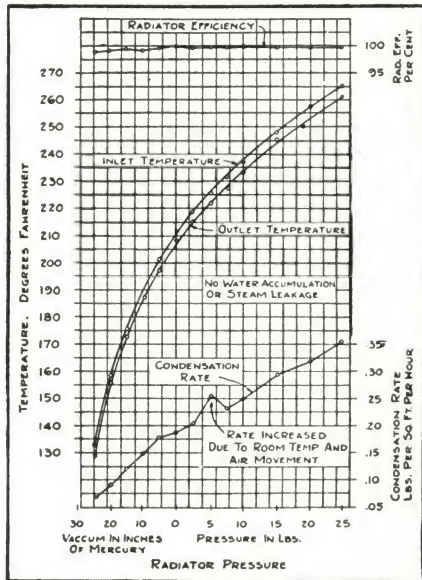


Fig. 1060A

Chart Showing High Efficiency of Dunham D1 Trap Irrespective of Pressure

This shows that the radiator performed with a constant high surface efficiency averaging 99.94% for the test period 3 1/2 hours. This result was due to a complete release of air from radiator with no water accumulation nor steam discharge into vacuum return line by the Dunham D1 Radiator Trap

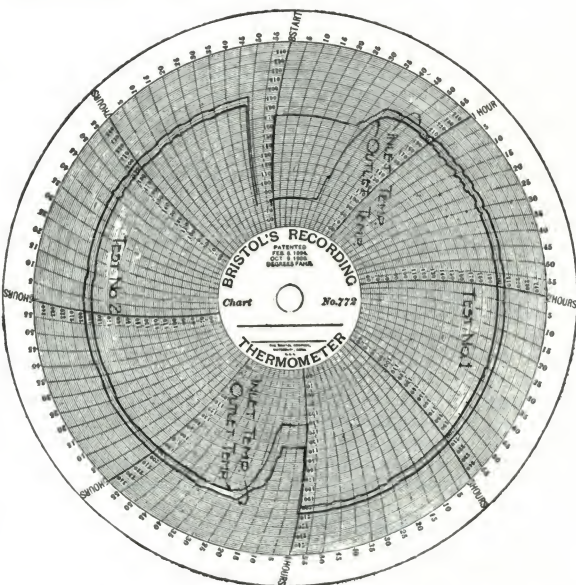


Fig. 1158

Inlet and Outlet Temperature is Uniform under Varying Degrees of Vacuum in the Radiator During Above Test

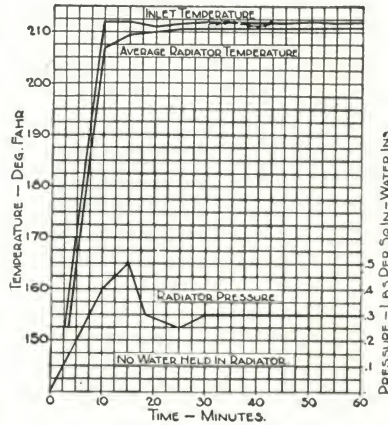


Fig. 908A

Chart Showing Rapid Warming of Radiator Equipped with Dunham Radiator Trap

Figures 908A and 931A show data which establish clearly that the condition of low average radiator efficiency pictured in Fig. 906 on Dunham page 6 is due to failure to release air and water.

It will be noted by comparison of charts Figs. 908A and 931A that the radiator equipped with a radiator trap very quickly becomes fully heated, which means that the air was released very quickly. There was no water held in the radiator. However, the radiator equipped with air valve was not fully heated at the end of the test period of one hour because the air was released so slowly. Water was also held in the radiator

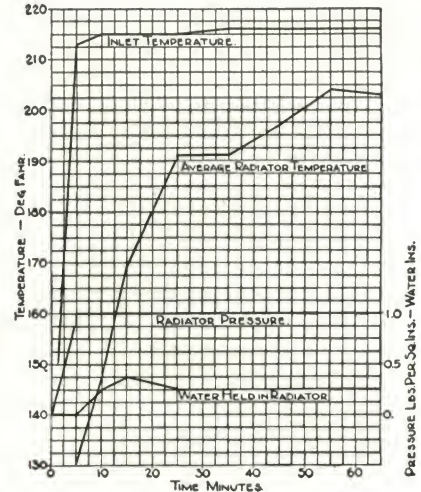


Fig. 931A

Chart Showing Slow Warming of Radiator Equipped with Air Valve

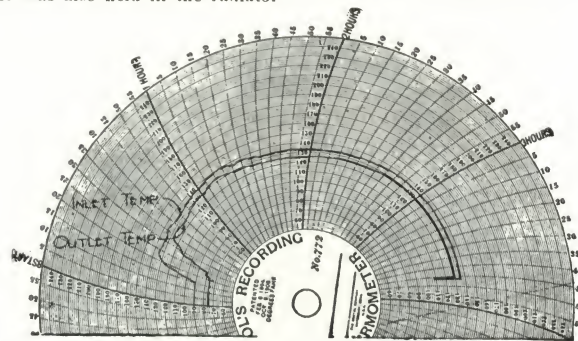


Fig. 1156

Inlet and Outlet Temperatures of a Radiator Showing Uniform Operation under High Vacuum

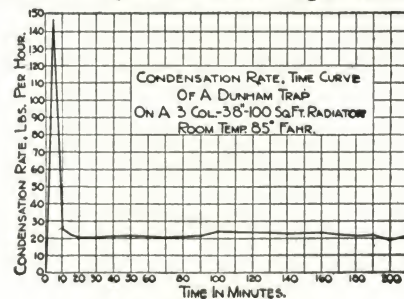


Fig. 966A

Test Showing the Radiator Condensing Rate Being High Even with a Room Temperature of 85° F.

SATISFACTORY HEAT

Important Factors in the Design of Modern Heating Systems

Designing Heating Systems

There are four important factors to consider when designing any heating system as well as any Dunham Heating System.

(1) The radiation must be ample to heat the building to the specified temperature in severe weather.

(2) The boiler must be of proper size for this load with a tight chimney of proper size, so as to obtain required draft.

(3) The piping, mains, risers and spring pieces must be of proper size, and properly planned.

(4) The Dunham specialties must be properly selected for the service they are to perform and they should be properly installed.

If these factors are thoroughly considered, according to accepted methods, the results should be satisfactory, but it must be remembered that even with ample and well-designed heating equipment, objectionable and chilling drafts cannot be avoided unless the building is reasonably tight.

Satisfactory Heat

A constant predetermined temperature maintained within a building irrespective of outside weather, is *satisfactory heat*.

Comparison of Present Heating Systems

One of the first types of steam heating systems used was the One Pipe System. The steam was expected to enter the radiator through the same pipe that the water of condensation returned to the boiler. The air, originally in the radiators, and that entering subsequently, was expected to find its way from the heating system through the air valve on each radiator. The exit provided for the release of air was small, so the release of air was not rapid and was compressed in the radiator, keeping a large portion of its surface cold, and mixing with the steam prevented the surface from transmitting its maximum heat.

The Two Pipe Heating System was another attempt toward securing satisfactory heat by merely adding a second pipe to the system, but did not overcome the defects of the One Pipe System, because the air valve was still relied upon for the release of air. Furthermore, steam from one radiator would pass into another radiator through the return piping (see Fig. 906), thus pocketing the air in the radiator between two walls of steam and preventing the radiators from thoroughly heating. The condensate, in trying to leave the radiator, encountered this steam

This heat must be delivered noiselessly, economically and be quickly available in the quantity desired wherever and whenever wanted. A satisfactory heating system will supply through the radiators an amount and degree of heat which will balance heat loss from the building and maintain constant inside temperature. It is equally important that a modified heat be supplied during the milder weather which exists in most localities for 95% of the heating season, as well as that an adequacy of heat be available for the most severe weather.

Overheating has long been an engineering problem. The Dunham Differential Vacuum Heating System solves that problem and gives *satisfactory heat*.

During the greater part of the heating season this system heats the building with steam at sub-atmospheric pressures; this means steam at temperatures less than 212° which results in a pleasant, comfortable and healthful heat.

The Dunham Thermostatic Radiator Trap makes such heat possible. It automatically permits the heat to be distributed quickly, noiselessly and uniformly throughout the system.

from the return line, resulting in water hammer and pounding.

The Dunhamized two pipe systems using the Dunham Thermostatic Trap completely overcame these troubles. See Fig. 907D. They were the last word in steam heating until the advent of the Dunham Differential Vacuum Heating System, see

Fig. 1163A and also Figs. 1062G and 1247B on Dunham pages 13 and 14, respectively, which show typical installations for large buildings.

The Dunhamized two pipe systems such as the Home Heating, Return and Vacuum Return Line Heating Systems, however, lacked the ability to operate over a sufficiently wide range of pressures to permit ready control of the heat output in response to the wide variation in weather conditions encountered. Moreover, it could not readily operate with steam at sub-atmospheric pressures because the control was not suited for the purpose.

The Dunham Differential Vacuum Heating System, therefore, provides all the advantages of previous heating systems but with the added advantage of greater economy, increased responsiveness, flexibility and comfort.

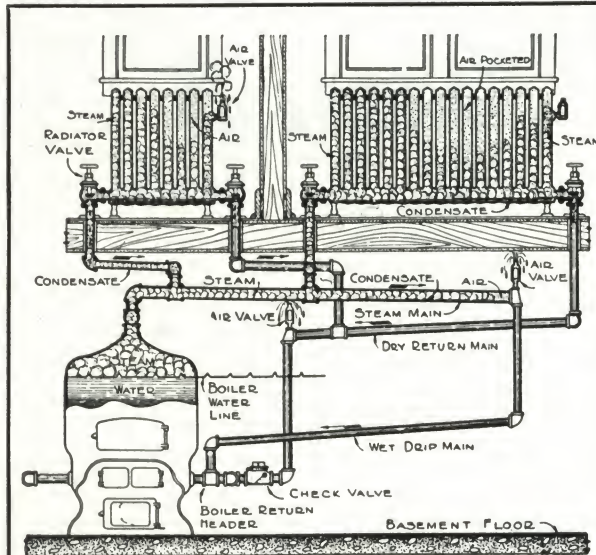


Fig. 906. The Old Two Pipe Heating System

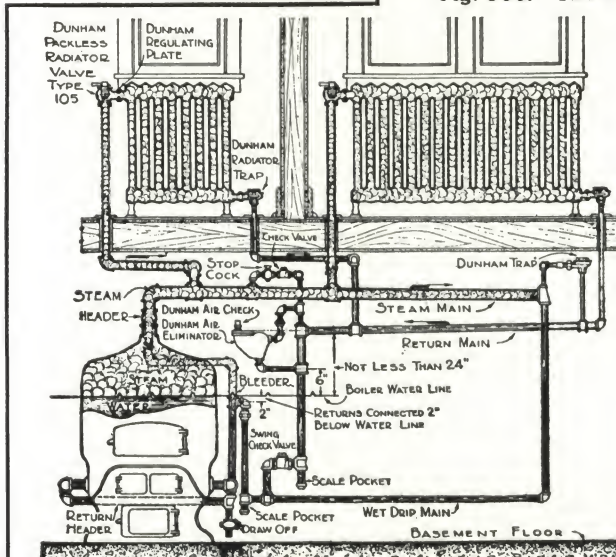


Fig. 907D. The Dunham Home Heating System

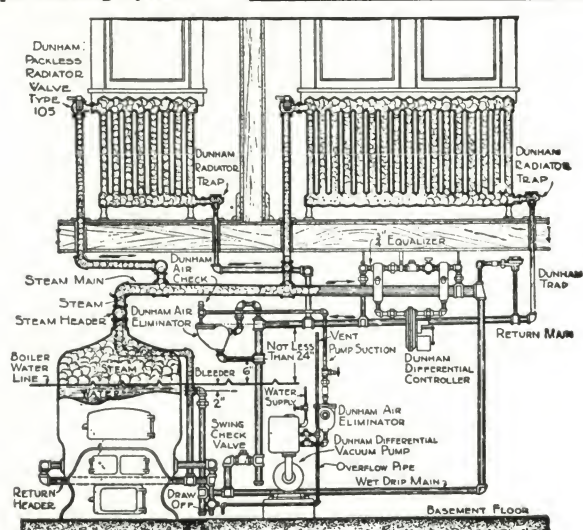


Fig. 1163A. Dunham Differential Vacuum Heating System for Homes

DUNHAM DIFFERENTIAL VACUUM HEATING SYSTEM

Heating with Steam of Variable Temperatures—Cool Steam (133° F.)

Warm Steam (133° to 212° F.), Hot Steam (above 212° F.)

The heating profession has long realized that there is a large amount of heat wasted in mild weather because buildings are overheated. The cause of this waste in steam heating systems is that most all of them are operated on and limited in their operation to pressures above atmospheric, even in mild weather. Steam pressures ranging from a few ounces to 2 or 3 lb. afford but a small operating range of steam temperatures to meet changes in weather conditions. That is, steam at a relatively constant pressure is usually supplied to the radiators regardless of what the outside weather may be.

The heat output of the radiators will therefore, be entirely too high in mild weather, when only a fraction of the radiation installed would actually be required to balance the heat loss of the building and maintain the desired temperature. The building temperature will increase above that desired, resulting in excessive heat loss from the building structure. This is generally termed overheating and represents a direct waste of fuel.

In designing a heating system sufficient radiation must be provided to heat the building to a specified temperature during extreme weather. The base temperature for designing the radiation is selected accordingly, usually with an assumed operating pressure of 1 to 5 lb. This results in more radiation being installed than is needed for moderate weather and an excessive amount for mild weather. Consequently, with steam circulating on pressures at atmospheric or above, overheating occurs during both mild and moderate weather, if steps are not taken to control the loss. Government weather reports show that extreme weather pre-

vails during about 5 per cent of the average heating season when the system must be operated at full rating. This leaves 95 per cent of the heating season when the heat output of the system must be reduced if uniform room temperature is to be maintained.

Daily weather reports show that the temperature rises and falls quite rapidly over the greater portions of the country. Temperature changes of 40 deg. per day occur each winter in the Chicago area, while daily changes of 20 deg. are but slightly higher than normal. To this variation in heat demand must be added the cooling effect of wind, if a true picture of the great fluctuations in heating requirements is wanted.

The graph, Fig. 1288, shows the official maximum and minimum temperatures at Chicago for each day of the heating season of 1928-29. It clearly shows the temperature fluctuations for that season and also the extreme limits of temperature recorded in the previous 54 years. During that year, there was a total of 131 hours when the temperature was 10 deg. or lower, with but 35 hours of this at zero or below. The heating season was but 0.4 deg. warmer than the average since the year 1900.

This statement of the great variation in weather conditions from day to day is simply to point out that progress toward comfort and economy in heating should be made by making the heating system very flexible in heat output. The ideal in heating is to have output of the system just equal to the heat loss from the building if uniform room temperature is to be maintained and heat waste through overheating is to be eliminated, and the accompanying excessive open window loss is to be prevented.

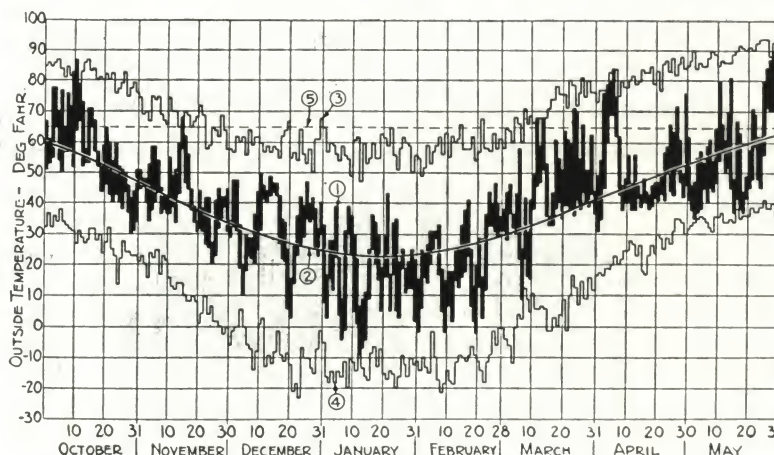


Fig. 1288. Average Temperature for Chicago Heating Season 1928-29 = 40.2°

- (1) Maximum and minimum daily temperatures for 1928-29.
- (2) Normal daily temperature for 1928-29.
- (3) Highest temperature on record.
- (4) Lowest temperature on record.
- (5) 65° temperature base for degree day calculation.

PRINCIPLES AND DESIGN OF DUNHAM DIFFERENTIAL SYSTEM

The principle of the Dunham Differential Vacuum Heating System is based on the fundamental laws of heat flow and heat processes. The basis of the theory is briefly summed up in the statement of its object—to maintain steady temperatures inside a building throughout the heating season, irrespective of the daily and hourly fluctuations of the outside weather.

No Complicated Equipment Required

The Differential Vacuum Heating System accomplishes this without any complicated or delicate equipment, or any greater variety of appliances than is used by the ordinary Vacuum Return Line Heating System. No larger or special boiler is required on this system than on any other. Any type of boiler suitable for heating work and of high efficiency can be used.

Easily Adaptable to Change-over From Existing Vacuum Return Line Systems

An ordinary, well-designed, Vacuum Return Line System can

be changed over to the Dunham Differential System. Radiation does not have to be disturbed and in most instances existing piping may be used with only slight changes.

Steam Furnished at Variable Temperatures Is the Secret of Comfortable, Economical Heat

The system uses steam as a heating medium. This steam is supplied from the boiler direct or through controlled valves to the radiators at variable temperatures from 133 degrees up to 212 degrees and higher if so required. The 133 degrees temperature corresponds to 25 in. of vacuum (at sea level), and 212 degrees to zero on the gauge. By furnishing steam at this wide range of temperatures, it is possible to vary the heat output of the radiation thus preventing overheating. For instance, in mild weather, steam is supplied at a low temperature, therefore the radiator will give off only a slight amount of heat (in fact one can hold his hand on the radiator). As the weather gets colder higher temperature steam is furnished until finally in severe weather there may be a pressure on the radiation instead of the high vacuum used in mild weather.

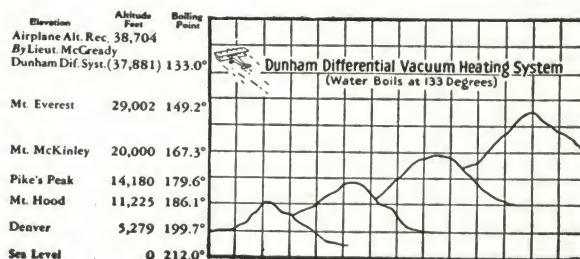


Fig. 1220A

DUNHAM DIFFERENTIAL SYSTEM (Continued)

Based on Bed-Rock Laws of Physics

This system is simple in design, easy to install and very economical in operation.

No new principle is used to attain the long sought combination of comfortable heat at all times, with real economy. The application of the Dunham Appliances which utilize this important principle is the only thing new. These appliances are

attention-compelling and revolutionary. They have made the Dunham Differential Vacuum Heating System the outstanding heating development of the decade, and one destined to work as radical a change in present-day heating methods as did the Dunham Thermostatic Radiator Trap when it revolutionized steam heating a quarter century ago.

A Simple Description of the Principle

It is generally known that water boiling at sea level will generate steam at 212 degrees while up in the higher altitudes where the atmospheric pressure is less, water will boil at much lower temperatures. (See opposite page.) For instance, in Denver, which is at an altitude of 5279 feet above sea level, water will boil and generate steam at about 199.7° F.

The same pressure conditions are duplicated in the boiler and system of the Differential Vacuum Steam Heating System. The temperature of the steam is governed by the Dunham control equipment and the Dunham Differential Vacuum Pump, which removes the air from the system, thereby reducing the

pressure on the water in the boiler, or causing the steam to expand through Reducing Valves when they are used.

The term "Differential" is applicable because a relatively constant differential in pressure between the radiator and the return is maintained, so that the air and water will constantly flow out of the radiators. The steam is induced to completely fill them. Due to this "Differential" complete circulation is obtained and the radiators throughout the building are heated uniformly. The "cool" steam gives a "mild heat," which prevents overheating. This is more healthful, and less destructive to decorations and furniture, than the "hot" steam used in ordinary types of systems.

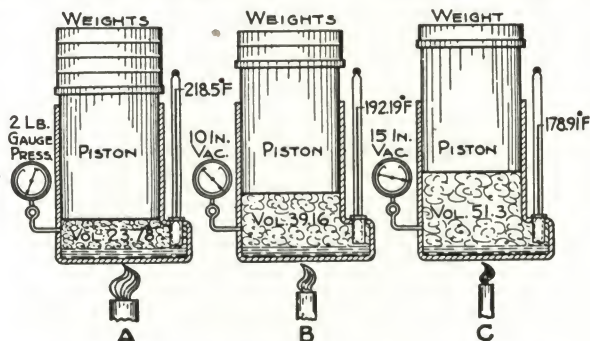


Fig. 1078A. Relation of Boiling Point and Specific Volume to Pressure

The temperature at which water will boil depends upon the pressure over the surface of the water.

By lowering the pressure on the water its boiling point is lowered over a wide range as is shown by the curve below.

The boiling point of water is the temperature at which it vaporizes without change in temperature, for the given pressure. As the boiling temperature decreases the specific volume increases.

For example, assuming the vessel "A" (Fig. 1078A) is a boiler with sufficient weights to create 2 lb. pressure on the water and sufficient fire under it to evaporate only one pound of water, the space occupied by this pound of steam will be 23.78 cu. ft. The temperature of the steam will be 218.5° F.

By removing sufficient weight a pressure of 10 in. vacuum can be secured and by reducing the fire under the boiler as shown by "B" so that only one pound of water is evaporated the same pound of steam will now have a temperature of 192.19° F. and will fill 39.16 cu. ft. of space.

Further reducing the pressure to 15 in. vacuum as in "C"

the pound of steam will have a temperature of 178.91° F. and will have a volume of 51.3 cu. ft. The volume of the pound of steam at this pressure (vacuum) is more than double the volume of the pound of steam at 2 lb. gauge pressure.

This relation of steam temperatures and volume may be carried on up the range and at 25 in. vacuum it will have a temperature of 153.22° F. with a volume of 145 cu. ft. or over six times greater than that at 2 lb.

The Dunham Differential System utilizes these properties of steam.

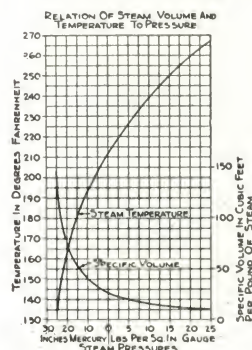


Fig. 1079

THE HEAT EMITTED BY A RADIATOR DEPENDS ON THE TEMPERATURE DIFFERENCE BETWEEN THE RADIATOR AND THE AIR OF THE ROOM.

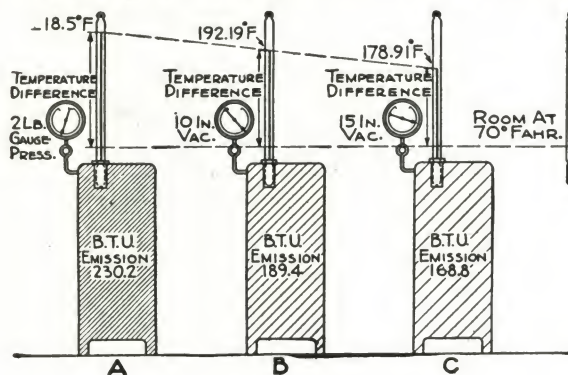


Fig. 1083A. Heat Emission from Radiation Under Varying Pressure and Temperatures

The heat given off by the radiator is proportional to the difference in temperature between the room and the radiator. By varying the temperature of the radiator, the building temperature can be kept constant, and the heat given off by the radiator kept in proportion to the heat loss from the building. By operating the system at varying degrees of pressure or vacuum the temperature of the steam supplied to the radiators is varied to suit the changing weather conditions. This is the basic principle of the Dunham Differential Vacuum Heating System. (See Fig. 1083A.)

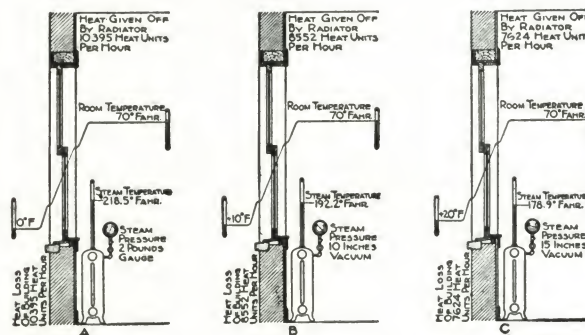


Fig. 1075A Relation of Heat Loss and Heat Emission to Temperature Difference

This illustration shows how the room temperature is maintained uniformly under changing weather conditions, by varying the steam pressure so that the heat given off by the radiator equals the heat lost by the building.

DUNHAM DIFFERENTIAL SYSTEM (Continued)

Fuel Saving of 25% or More Compared with Ordinary Types of Steam Heating Systems

On buildings changed over to the Dunham Differential Vacuum System the performance records show actual fuel savings of 25% or more compared with previous system. Thus the heat from 75 tons of fuel results in heating comfort for the same space as required 100 tons or more under the old method. This saving is accomplished with greater heat comfort to the occupants of the space heated with a resultant greater rental value to the owner.

The charts and illustrations on this page tell this story in a non-technical way.

Fig. 1066C, Steam Table Applied—This drawing gives a comparison of the properties of steam

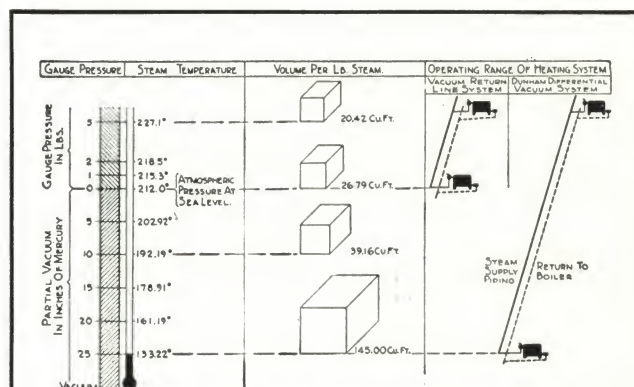


Fig. 1066C. The Steam Table Applied

Comparison of steam pressures, volumes and corresponding boiling points. Steam is produced at lower temperatures and circulated just as easily at 20 in. of vacuum as at 2 to 3 lb. gauge pressure

as used in the ordinary type heating system and the Dunham Differential Vacuum System.

The Ordinary System Has—

- (1) Operating range zero to 5 lb. gauge pressure or higher.
- (2) Temperature range 212° F. to 227.1° F.
- (3) Volume per lb. steam 26.79 to 20.42 cu. ft.

The Dunham Differential Vacuum System Has—

- (1) Operating range 25 in. vacuum to 5 lb. gauge pressure or higher.
- (2) Temperature range 133.22° F. to 227.1° F.
- (3) Volume per lb. steam 145 to 20.42 cu. ft.

By comparing the steam volumes and temperatures used in the two types of systems an index to the flexibility of each is obtained. The extreme flexibility of the Differential System eliminates overheating and reduces the heat lost through open windows.

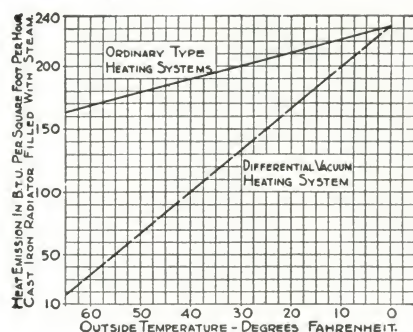


Fig. 1089A. Comparative Heat Emission from Radiators

This chart of heat emission from radiation is based on the room temperatures that would be obtained as shown by Fig. 1113A.

For example when the outside temperature is 30° F. with the ordinary type heating system the room would be overheated to 90° F. as noted from above graph. Using steam at zero gauge pressure (212° F.) the heat emission would be 200 B.t.u. per square foot per hour.

By controlling the pressure at which steam is supplied as in the Differential Heating System the heat emission is controlled in proportion to the outside weather. Using the same example with 30° F. outside, the heat emission of a radiator on the Differential System would be 132 B.t.u. per square foot per hour keeping the room substantially at 70° F. The effect of sun, wind and humidity on the building has not been considered in above graph. During cold and average weather the steam is furnished in sufficient quantity to completely fill the radiator at required degree vacuum. During mild weather the radiator may be only partly filled with steam under high vacuum.

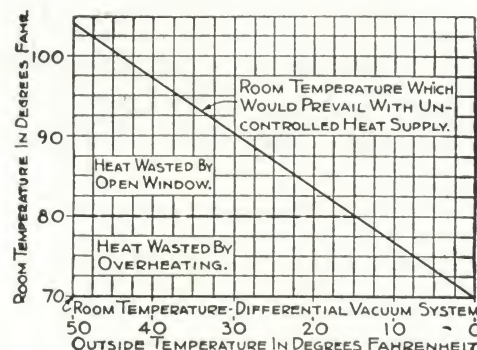


Fig. 1113A. Heat Saved by Controlling Heat Supply

This drawing shows the heat lost by overheating and wasted through open window in relation to the room temperature and the outside, disregarding the effect of sun, wind and humidity.

With the ordinary type heating system with uncontrolled heat supply the room or building would overheat in direct relation to the outside weather.

It was found by observation that occupants would allow room temperatures of approximately 80° F. before windows would be opened, we have therefore termed the excess heat between 70° and 80° as wasted through open windows. The diagonal line indicates the temperatures that would be attained if windows were kept closed, which is approximately same as would be lost if the windows were open.

Summary of Test Data Showing Economies Effected by the Dunham Differential System Over Former Systems

This summary is simply to bring to the architect's attention some examples of actual savings made by changing over from ordinary vacuum systems to the Dunham Differential System.

Complete, authentic records are on file at any of our offices and may be had on request. We give below only the names of a few jobs and the actual saving in percentages.

JOB	LOCATION	SAVINGS PER CENT	JOB	LOCATION	SAVINGS PER CENT
The Temple Bldg.	Rochester, N. Y.	37.92	Barry Apartments	Chicago, Ill.	32
Prairie Oil Gas Co. Bldg.	Independence, Kan.	44.08	Hotel Winthrop	Tacoma, Wash.	42.5
Medical Arts Bldg.	Portland, Ore.	25.46	Rienza Hotel	Chicago, Ill.	27.1
Standard Oil Co. Bldg.	Omaha, Neb.	35.7	Golden High School	Golden, Colo.	50.17
Delaware Bldg.	Akron, Ohio	27.46	Douglass High School	Douglass, Kan.	25.8
Butler County Jail	Allison, Iowa	52.5	Danley Mach. Spec.	Chicago, Ill.	55.52

DUNHAM DIFFERENTIAL SYSTEM (Continued)

General Description of Parts and Operation

The Dunham Differential Vacuum Heating System is a two-pipe system using steam at pressures less or greater than atmospheric pressure. The parts are very similar to the well known vacuum return line heating system of which this is a further development. The system may be controlled manually or automatically, as described on this and the following pages.

Fig. 1062G shows a typical layout of a manually controlled system having a steam source with Dunham Sub-atmospheric Reducing Valves to supply steam at the desired temperature in the radiation; a properly designed system of steam piping; a Dunham Packless Radiator Valve, with regulating plate in the inlet of each radiator; a Dunham Thermostatic Trap on the outlet of each radiator; a system of return piping; a Dunham Differential Vacuum Pump with Differential Controller. This controller is governed by the pressure difference existing between the radiation and return piping.

Any Good Piping Job Is Sufficient

The piping is assembled so as to remain tight over a long period of years, just the same as is required for any other good job. The same quality of workmanship which is used to assemble the hot water supply piping is easily sufficient if proper provision is made for the slightly greater expansion.

Control of Steam Supply

In smaller installations steam is supplied at the same vacuum (absolute pressure) at which it is to be used in the heating system by controlling the rate of heat generation at the boiler. On larger installations and on central station installations steam is furnished at a higher pressure than is required by the system and is reduced by means of pressure reducing valves to the desired vacuum or absolute pressure. These valves may either be manually or thermostatically controlled.

Wide Range of Flexibility

Heating Systems are seldom operated for 24 hours per day except in very severe weather, so the building is usually below the required temperature when the heating plant is started up each morning. The building may be brought



Trap Used on Differential Vacuum Heating Systems

up to temperature slowly, or rapidly, as desired, by circulating steam at say a 10-in. vacuum or even on pressures above atmosphere. When the building is up to the desired temperature on manually controlled systems the engineer can set the pressure reducing valve for the vacuum required to maintain the room temperature; on automatic installation the thermostat will govern. The amount of steam to be supplied under this vacuum will, naturally, depend on the rate of heat loss from the building at the time.

Regulating Plate at Each Radiator Assures Uniform Steam Distribution

By careful design and installation of a piping system, it is possible to get a distribution of steam at pressures which are fairly uniform throughout the piping. The use of a regulating plate in each radiator inlet valve assists steam distribution at all periods of the heating cycle. They interpose a small resistance to the flow of steam and create a reservoir condition within the supply piping, thus equalizing the pressure conditions at the entrance of each and every radiator.

How the Radiator Trap and Regulating Plate Prevent Excessive Heat Loss

During the heating-up period and while the radiators are filling with steam, the radiator traps are open to the return pipe and they remain open until steam reaches the trap, when they close.

When the radiators are completely filled with steam and under normal operation, the regulating plates, as already stated, produce a semi-reservoir condition in the steam mains as compared with the condition when filling, by supplying an area for the flow of steam that is in proper relation to each size of radiator; if through some abnormal condition, the condensing rate of some radiator would be increased, the regulating plate will tend to prevent such a radiator from condensing an excessive amount of steam, notwithstanding the demand for it. This is of value in reducing heat loss through excess window ventilation.

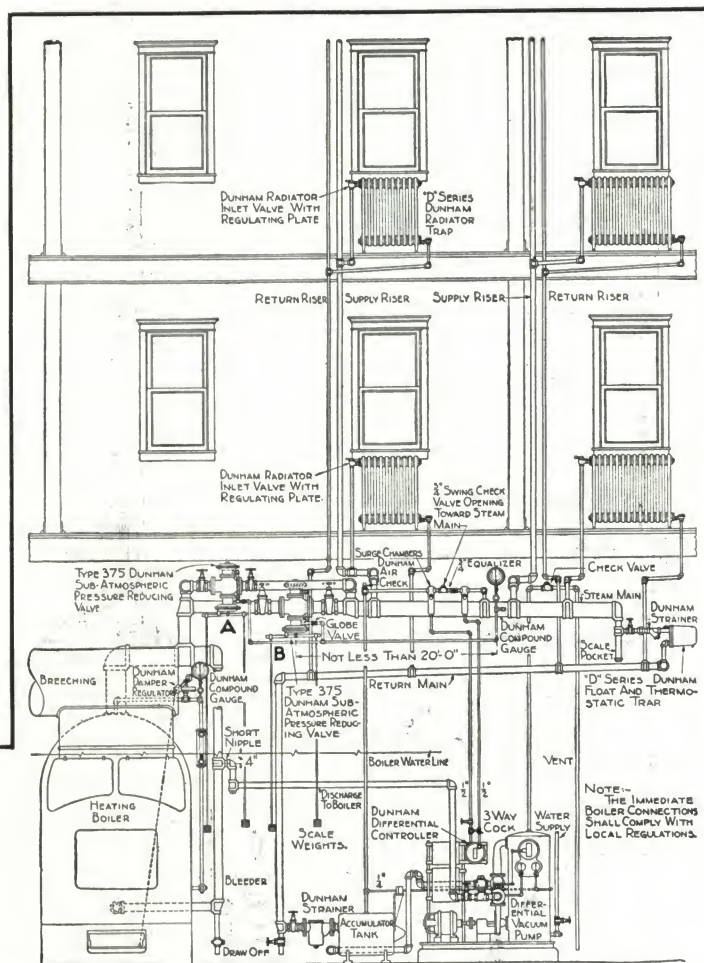


Fig. 1062G. Typical Layout of a Manually Controlled System for Heating with Steam Below Atmospheric Pressure

Note: See Fig. 1247B, Next Page, for Automatically Controlled System



The Dunham Differential Vacuum Heating System and individual parts of the apparatus used in that system are fully protected by United States Patents Nos. 1,644,114, 1,706,401, 1,727,965, 1,761,819 and 1,771,077; Canadian Patents Nos. 282,193, 282,194 and 282,195. Additional patents in the United States, Canada and foreign countries are now pending.

DUNHAM DIFFERENTIAL SYSTEM (Continued)

General Description of Parts and Operation (Continued)

Exact Heat Control for Mildest Days

Radiators of a heating system completely filled with steam under varying degrees of vacuum meet the average heat loss required during a season, but early autumn and late spring days with very much higher outside temperatures, require such a small heat output that even with a high vacuum, a radiator full of steam at a temperature corresponding to that pressure (vacuum) might under such conditions overheat the building if the system was not capable of further heat reduction. In the Dunham Differential System the quantity of steam supplied during such periods is reduced under a high vacuum, and the regulating plate controls its admission to each radiator so that each remains partly filled, balancing the heat input to the radiator with the heat loss of the building.

Thermostatic Radiator Traps

The thermostatic radiator trap on the outlet of each radiator is of importance, for by its use a positive differential can be maintained between the pressure (vacuum) in the radiator and the pressure (vacuum) in the return pipe, thus securing satisfactory heating.

Steam Circulation Is Maintained by Jet Exhauster Type Vacuum Pump

Steam circulation is maintained by the Dunham Differential Vacuum Pump capable of producing a high vacuum. The pump motor is controlled by the Dunham Differential Controller which is an automatic electric switch actuated by the pressure difference in the radiation and return piping. The function of this controller is to automatically start or stop the pump so that a small but substantially constant pressure difference is maintained. This differential will furnish a head sufficient to cause steam flow toward the returns.

System May Be Manually or Automatically Controlled

There are three distinct methods of heat control:



Trap Used on Differential Vacuum Heating Systems

(a) Manual Control, using Dunham Sub-atmospheric Reducing Valves, adjusting these so as to furnish a uniform sufficient flow of Sub-atmospheric Steam. This method and method B are used in the "D" series system. (See Fig. 1062G.)

(b) Automatic Control, by the additional function of an automatic valve controlled from one or more Room Thermostats. This automatic valve takes the place of the larger of the Sub-atmospheric Reducing Valves. (See Fig. 1247B.)

(c) Automatic operation, as used in the "DH" series system and also in such "D" series installations in which the boiler is controlled by a Room Thermostat.

Automatic Control by Thermostats—Fig. 1247B illustrates a typical layout of a heating system which gives automatic control of the steam supply.

Thermostats located in key rooms are used to control the operation of the larger of the two supply valves previously referred to. This valve, located directly in the steam main, is a motor operated valve. Its function is to admit additional steam to the heating system when the room thermostat calls for heat and to stop this flow when it is no longer required.

The room thermostats are electrically connected to the motor of this valve through a control panel, arranged so that the steam in the system may be either automatically controlled or manually controlled when special conditions may demand it.

In buildings where varying wind conditions cause different demands for heat on the windward side, the use of several thermostats located on different sides of the building in separate key rooms has been the practice. The heating system may be under the control of any one of these thermostats.

The Zoning System—As buildings become larger or as the use of their several parts are more varied, it has been found that more economical means of satisfactory heating will be obtained by using a multiple system called zoning.

Note: This system is described in detail on Dunham pages 19, 20, 21.

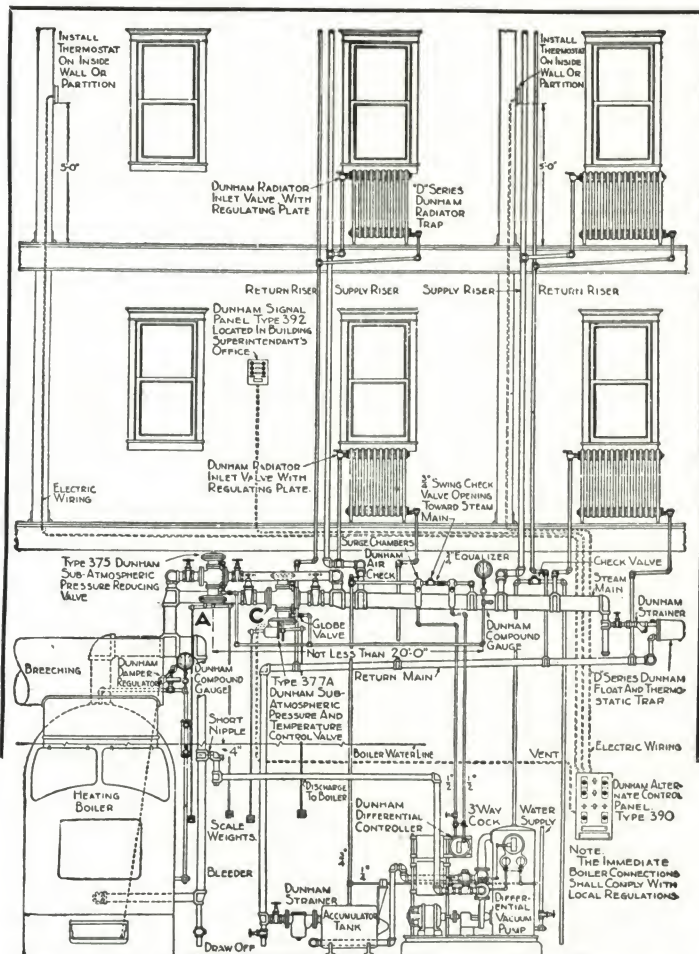


Fig. 1247B. Typical Layout of an Automatically Controlled System for Heating with Steam Below Atmospheric Pressure

Note: See Fig. 1062G, Preceding Page, for Manually Controlled System



The Dunham Differential Vacuum Heating System and individual parts of the apparatus used in that system are fully protected by United States Patents Nos. 1,644,114, 1,706,401, 1,727,965, 1,761,819 and 1,771,077; and Canadian Patents Nos. 282,193, 282,194 and 282,195. Additional patents in the United States, Canada and foreign countries are now pending.

DUNHAM DIFFERENTIAL SYSTEM (Continued)

The "D" Series for Large Buildings—Over 3000 Sq. Ft. Equivalent Direct Radiation
Manually or Automatically Controlled

The "D" series Dunham Differential Vacuum System is for the heating of office buildings, hotels, apartment houses, schools and groups of buildings, etc. It is for use on any system with more than 3000 sq. ft. of equivalent direct radiation.

In this system the boiler serves as a heat storage from which steam is supplied according to the demand of the Sub-Atmospheric Pressure Reducing Valve or Temperature Control Valve. The manually controlled system (see Dunham page 13) uses two sub-atmospheric pressure reducing valves. The small valve "A" supplies steam in mild weather, valve "B" in cold weather. In extreme weather both valves may be used, if necessary. By shifting the weights of the valve in use, the steam pressure (vacuum) is controlled in accordance with outside weather conditions.

In the automatically controlled system (see Dunham page 14) a Temperature Control Valve "C" is substituted for valve "B."

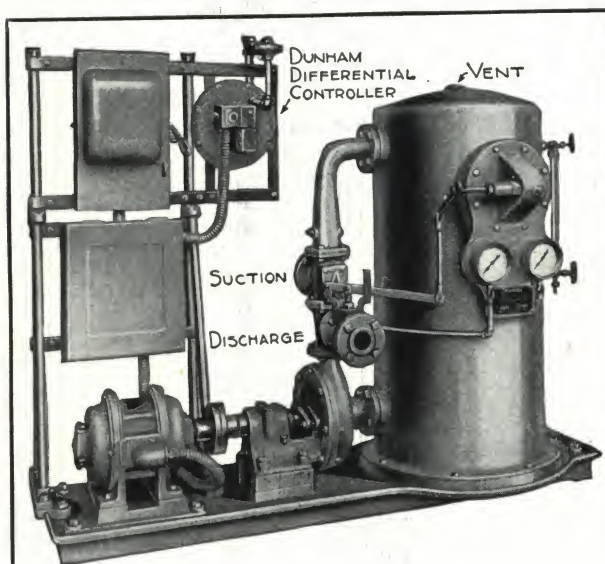
The Dunham Differential Controller

This starts and stops the pump maintaining, under all steam supply conditions, a greater vacuum in the returns than in the radiators.

This assures complete circulation at all times. In severe weather when steam pressure above atmospheric is required (to maintain the room temperature) the Differential Controller automatically stops the pump until pressure conditions in the system make its operation necessary.



The Dunham Differential Vacuum Heating System and individual parts of the apparatus used in that system are fully protected by United States Patents, Nos. 1,644,114, 1,706,401, 1,727,965, 1,761,819 and 1,771,077; and Canadian Patents Nos. 282,193, 282,194 and 282,195. Additional patents in the United States, Canada and foreign countries are now pending.



Dunham Differential Vacuum Pump, "D" Series

The Dunham Differential Vacuum Pump operates on the Jet Exhauster principle. The Dunham Exhauster is a special design and has great air and vapor handling capacity. Under high pressures water is supplied from the receiving tank to the exhauster by a motor driven enclosed impeller type centrifugal pump of high efficiency.

The pump exhausts air and water from return piping under very high vacuums and discharges condensate to the boiler. It is a completely assembled compact unit ready for piping and wiring connections.

For Complete Details, see Dunham Pages 17-18.

Central Station Heating

The Dunham Differential Vacuum Heating System is especially adapted to Central Station Steam Supply, both from the standpoint of the Central Station Company and the Consumer. It offers great economy of steam consumption, low condensate temperatures, complete circulation even though the pressure carried on the distributing mains from the boiler plant is low.

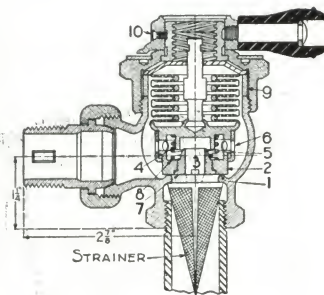
Exhaust Steam

Exhaust steam may be circulated under vacuum, thus saving steam formerly wasted. Greater economy and greater capacity of engines or pumps is also secured. The application of this system reduces the back pressure to a vacuum and greater power output will be obtained at reduced steam consumption.

Process Work

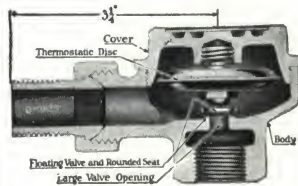
In installations where high steam pressures and temperatures are necessary for process work the building heating system can be operated more economically by applying the differential principle to it. By reducing the high steam pressure through reducing valves the heat input may be controlled and the over-all economy of the plant improved.

Heat Control Valve Type 180



For Details see Page 40

Dunham Thermostatic Radiator Trap

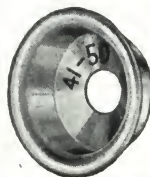


Sectional View of Trap

Sectional view of Dunham Differential Thermostatic Radiator Trap, sizes, styles and specifications, see Dunham pages 16, 35, 36, 37, 38

All traps used in connection with the Dunham Differential Vacuum Heating System are known as "D" Series. They function uniformly over a wide range of pressures and temperatures from 25 in. of vacuum to 25 lb. gauge pressure.

(See graph Fig. 1060A, Dunham page 5.)



Dunham Regulating Plate Type 192

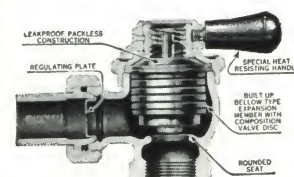
The Dunham Regulating Plate, which is inserted in the union of the Dunham Packless Radiator Valve, distributes the steam proportionately to each radiator.

For complete details see Dunham pages 35-36

Dunham Packless Radiator Valve

Dunham Packless Radiator Valves with Regulating Plate must be used on all radiators to secure proper balance. Either Type 105 (lever handle) or Type 145 (wheel handle) may be used.

The valve is made packless by means of the bellows construction. The plate orifice is calibrated to the number of feet of radiation in each radiator.



Sectional View, Type 105 Dunham Packless Radiator Valve with Regulating Plate

For sizes, styles and specifications, see Dunham pages 35, 36, 37, 38

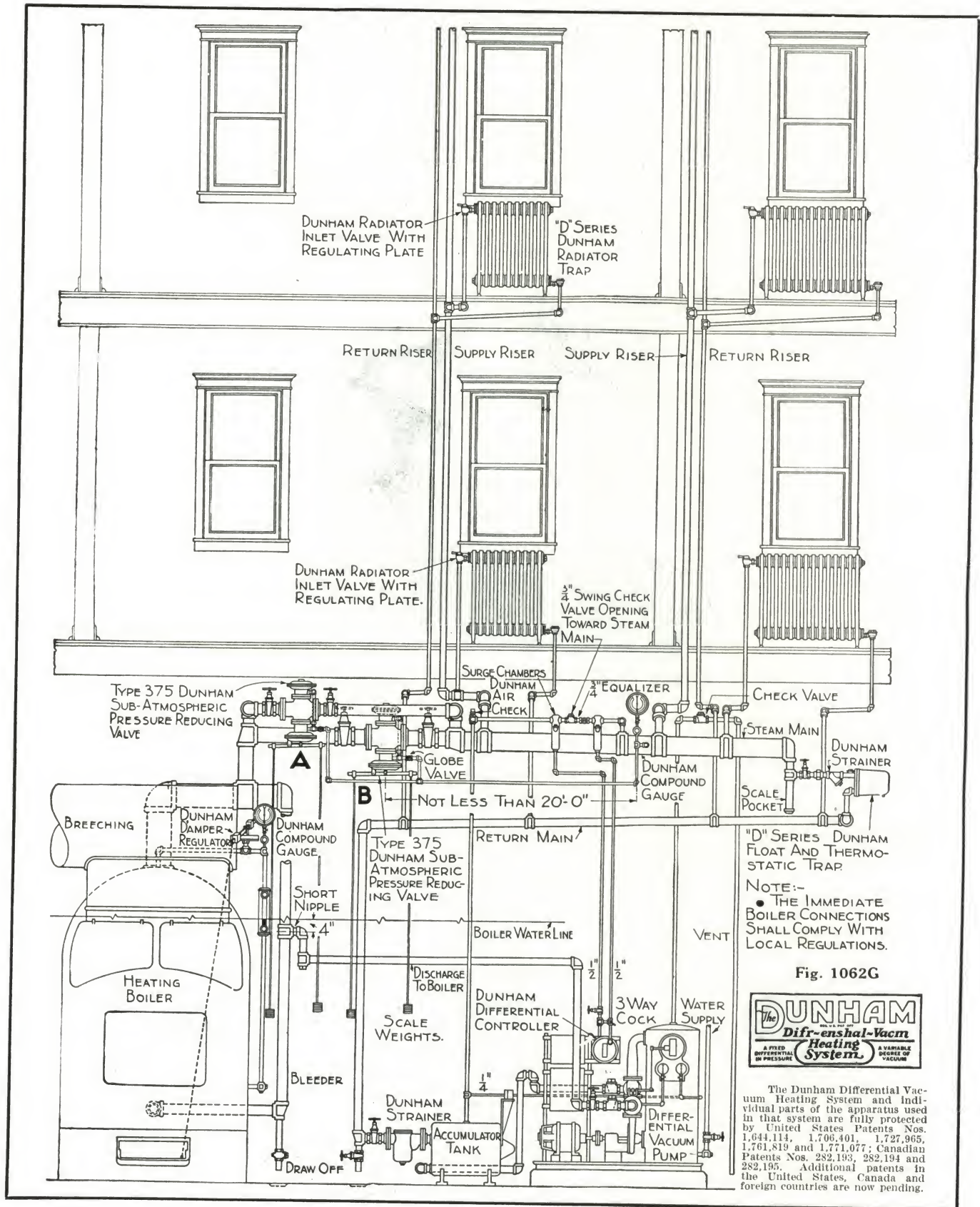
DUNHAM DIFFERENTIAL SYSTEM (Continued)

Fig. 1062G Typical Installation "D" Series Manual Heat Control—Method 1

For Specific Data on Parts, see Index, Dunham Page 3, This Catalogue

The building temperature is controlled by adjusting manually the two Dunham Sub-atmospheric Pressure Reducing Valves, the operator being guided by a thermometer in the

building. A long distance indicating or recording thermometer can be used to advantage, making the manual control very convenient.



DUNHAM DIFFERENTIAL SYSTEM (Continued)

Fig. 1247B Typical Installation, "D" Series Automatic Heat Control—Method 2

For Specific Data on Parts, see Dunham Pages 35 to 58, This Catalogue

In this method the control valve "C" is operated from a room thermostat and takes the place of the large Dunham Sub-Atmospheric Pressure Reducing Valve "B" in Fig. 1062G (on opposite page), making the control of the heat supply to the

building automatic. Valve "A" in this case will supply the minimum heating load and temperature while control valve "C" will supply the balance of heat in order to maintain the building temperature. For capacities of valve "C," see Dunham page 15.

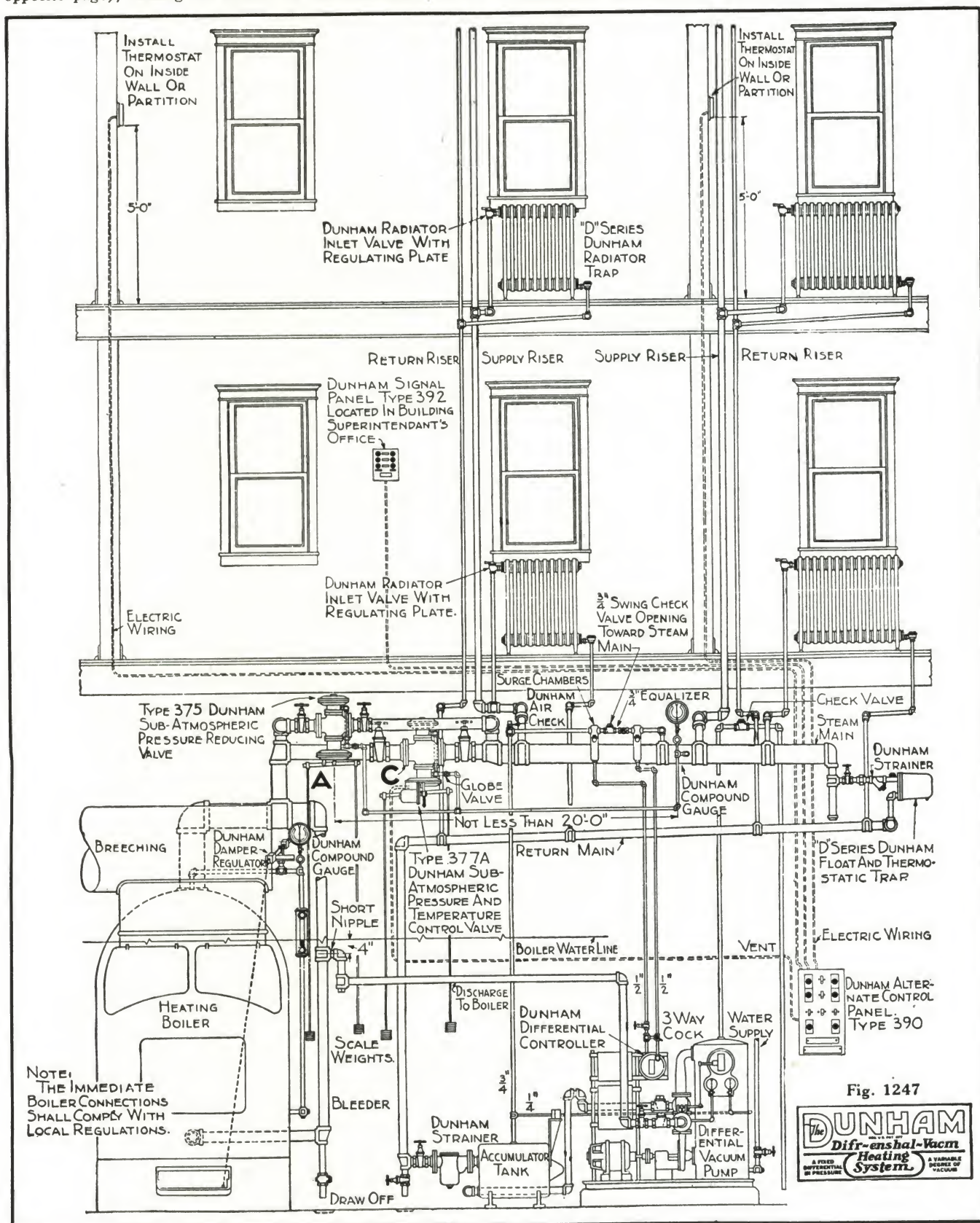


Fig. 1247



DUNHAM DIFFERENTIAL SYSTEM (Continued)

Sub-atmospheric Pressure Reducing Valve—Type 375A

These valves are for use only on Dunham Differential Vacuum Heating Systems. The maximum initial steam pressure must not exceed 10 lb. The reduced

pressure may be varied by adjustment from slightly below the initial pressure to sub-atmospheric pressures as low as 25 in. of vacuum.

For Type 377A Sub-atmospheric Pressure Reducing Valve, see Dunham Page 21

For Other Pressure Reducing Valves, see Dunham Page 50

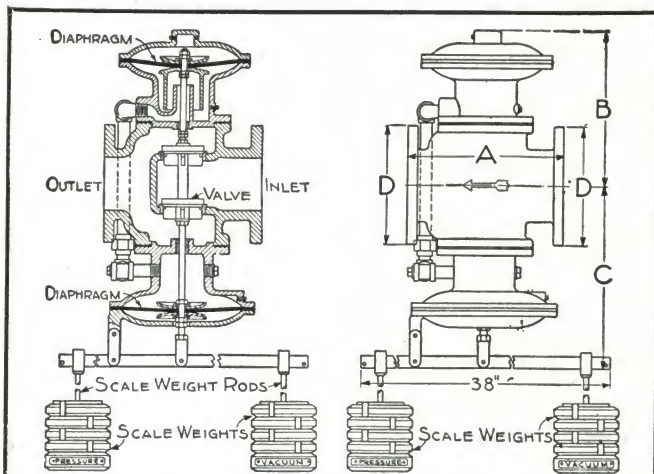


Fig. 1250A

TYPE 375A SUB-ATMOSPHERIC PRESSURE REDUCING VALVE

Pipe size, inches	Conn.	Dimensions in inches				Approx. shipping weight lbs.	Code
		A	B	C	D		
2	Flgd.	8 $\frac{3}{8}$	10 $\frac{1}{8}$	13 $\frac{1}{2}$	6	200	Arrow
3	Flgd.	10 $\frac{1}{4}$	12 $\frac{1}{8}$	14 $\frac{1}{2}$	7 $\frac{1}{2}$	235	Arrohead
4	Flgd.	12	12 $\frac{3}{8}$	15 $\frac{1}{8}$	9	300	Arroroot
6	Flgd.	15 $\frac{1}{2}$	15	17 $\frac{1}{2}$	11	485	Arroyo
8	Flgd.	19	16 $\frac{3}{4}$	19	13 $\frac{1}{2}$	655	Arsacid
10	Flgd.	19 $\frac{1}{2}$	18 $\frac{3}{16}$	20 $\frac{1}{2}$	16	770	Arsenal
12	Flgd.	26 $\frac{1}{2}$	20 $\frac{3}{8}$	22 $\frac{1}{2}$	19	850	Arsenic
14	Flgd.	30 $\frac{1}{2}$	22 $\frac{11}{16}$	25 $\frac{1}{16}$	21	920	Arsenide

Capacities of Type 375A Valves

Sq. Ft. Radiation	4500	6000	11000	18000	12000	55000	73000	114000	150000	200000
Size Small Valve A, Inches.....	2	2	3	3	4	4	6	6	8	8
Size Large Valve B or C, Inches.....	3	4	4	6	6	8	8	10	12	14

Example: Installation having 9200 sq. ft. of equivalent direct radiation excluding piping, requires:

(A) A 3 and 4-in. Sub-atmospheric Pressure Reducing Valve Type 375A for a manually controlled system (Application 1).

(B) A 3-in. Sub-atmospheric Pressure Reducing Valve Type 375A and a 4-in. Sub-atmospheric Pressure and Temperature Control Valve Type 377A (Application 2).

The sub-atmospheric pressure reducing valve is installed in the horizontal steam main as shown in Figs. 1149D, 1150E, and 1151F. In operation, sub-atmospheric pressures (vacuum) are secured by retarding the admission of steam into the steam heating main until the desired vacuum is reached. If the rate of steam admission is too great, pressure on the main increases causing the valve to partially close, thus reducing the steam supply which permits the vacuum desired to again be obtained. Adjustment allows a greater or lesser vacuum to be maintained on the outlet side of the valve.

Application 1 is a manually controlled Differential System using steam at not more than 10 lb. initial gauge pressure. For higher initial pressures see Application 3. Two Sub-atmospheric Pressure Reducing Valves are used as shown by Fig. 1149D. Valve "A" supplies steam in mild weather. The second valve, "B," supplies steam in cold weather. In extreme weather both valves may be used if necessary.

Application 2 is an automatically controlled system on which a Dunham Temperature Control Valve "C," operated from one or several thermostats is substituted for valve "B." Sub-atmospheric Pressure Reducing Valve "A" supplies steam in mild weather. As the weather becomes colder the Sub-atmospheric Pressure and Temperature Control Valve "C"

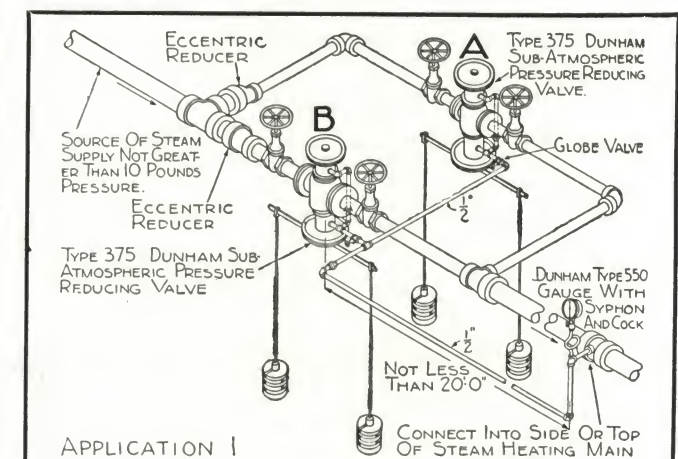


Fig. 1149D

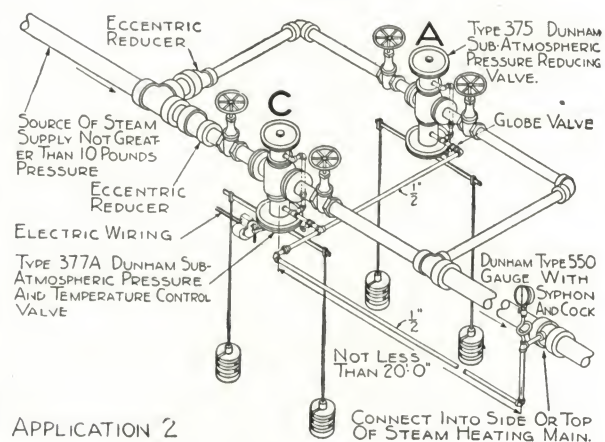


Fig. 1150E

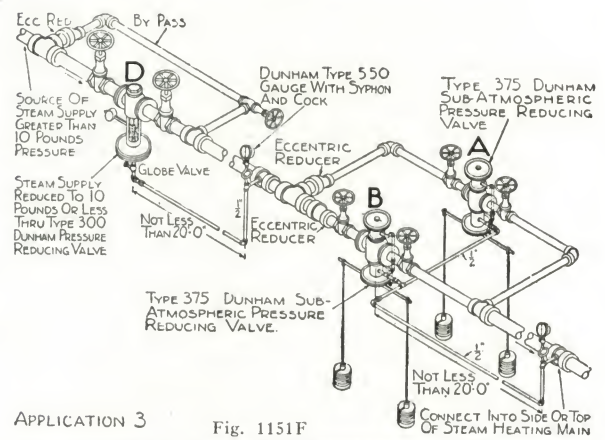


Fig. 1151F

supplies the necessary additional steam. The Thermostat must be placed in a typical room on the most exposed side of the building and at a point most remote from the source of steam supply measured along the steam piping. Its location should also represent the average building temperature and heat requirements.

Application 3 is a manually controlled system with initial steam pressure greater than 10 lb. gauge. The Pressure Reducing Valve "D" is used to reduce the steam pressure to 10 lb. or less before supplying the Sub-atmospheric Pressure Reducing Valves "A" and "B." If automatic temperature control is desired, valve "C" is substituted for valve "B." See Application 2.

DUNHAM DIFFERENTIAL SYSTEM (Continued)

Dunham Differential Traps—"D" Series

For Pressures 25 In. Vacuum to 25 Lb. Gauge

Thermostatic Radiator Trap

The Dunham Radiator Trap is an appliance which was first put into service in 1903 and completely revolutionized Steam Heating. It made the low pressure steam heating system practical. It automatically permits air and water to pass from the radiator without passing steam, consequently maintains the radiator at its maximum efficiency.

All traps used in connection with the Dunham Differential Vacuum Heating System are known as "D" Series. They function uniformly over a range of pressures and temperatures from 25 in. of vacuum to 25 lb. gauge pressure. Fig. 1060A, Dunham page 5, shows the performance of a Dunham D1 Radiator Trap over this range of pressures and temperatures.

For other Thermostatic Radiator Traps, see Dunham pages 36, 37, 38, 42, 45.

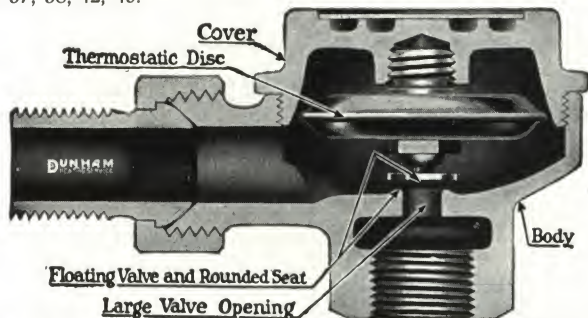


Fig. 819. Sectional View of Dunham Differential Thermostatic Radiator Trap

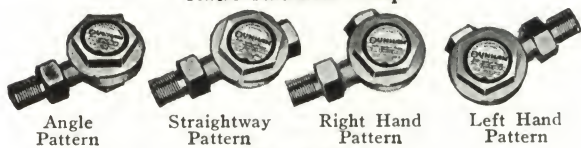


Fig. 1222

SPECIFICATIONS

(For pressures 25 in. vacuum to 25 lb. gauge)

Size	Style	Tapping, in.	Capacity direct radiation sq. ft.	Net wt.	Code	Dimensions, in.				
						A	B	C	D	E
No. D1	A.P.	1/2	100	22 oz.	Deatom	3 1/4	1 1/8	2 1/4	1 1/2	1 1/2
	S.W.	1/2	100	22 oz.	Deatude	3 1/4	1 1/8	2 1/4	1 1/2	1 1/2
	R.H.	1/2	100	22 oz.	Deattos	3 1/4	1 1/8	2 1/4	1 1/2	1 1/2
	L.H.	1/2	100	22 oz.	Deatwan	3 1/4	1 1/8	2 1/4	1 1/2	1 1/2
No. D2	A.P.	1/2	350	27 oz.	Deabhor	3 3/4	1 1/8	3 1/4	1 1/2	1 1/2
	S.W.	1/2	350	28 oz.	Deabbey	3 3/4	1 1/8	3 1/4	1 1/2	1 1/2
	R.H.	1/2	350	28 oz.	Deabate	3 3/4	1 1/8	3 1/4	1 1/2	1 1/2
	L.H.	1/2	350	28 oz.	Deabyss	3 3/4	1 1/8	3 1/4	1 1/2	1 1/2
No. D3	A.P.	3/4	800	28 oz.	Dealp	3 3/4	1 1/8	3 1/4	1 1/2	1 1/2
	S.W.	3/4	800	30 oz.	Dealper	3 3/4	1 1/8	3 1/4	1 1/2	1 1/2
	R.H.	3/4	800	30 oz.	Dealpine	3 3/4	1 1/8	3 1/4	1 1/2	1 1/2
	L.H.	3/4	800	30 oz.	Dealpest	3 3/4	1 1/8	3 1/4	1 1/2	1 1/2
No. D4	A.P.	3/4	1500	5 lb.	Dedrink	2 1/4	2 1/8	3 3/4	5	1 1/2
	S.W.	3/4	1500	5 lb.	Dedrench	2 1/4	2 1/8	3 3/4	5	1 1/2
No. D5	A.P.	1	3000	6 lb.	Dedrizzle	2 1/4	2 1/8	4	5	1 1/2
	S.W.	1	3000	6 lb.	Dedrifty	2 1/4	2 1/8	4	5	1 1/2

The Nos. D1 and D2 Traps are conforming with the standard dimensions "A" (3 1/4 in.) as adopted by the Heating and Piping Contractors' National Association for 1/2-in. radiator traps. The Nos. D1, D2 and D3 Traps are regularly furnished nickelplated, and with union nut and nipple, threaded right hand. Supplied in angle, straightway, right hand, or left hand pattern. Bronze body and cover.

The Nos. D4 and D5 Traps are painted blue and furnished in either angle or straightway patterns with female right hand threaded connections, both inlet and outlet. Cast iron body and cover.

The thermostatic discs are coated by a special process, which will lengthen the life of the traps by retarding normal corrosion.

When not otherwise stipulated on order the regular angle pattern traps of size called for will be shipped.

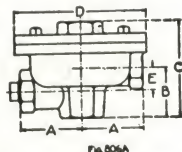
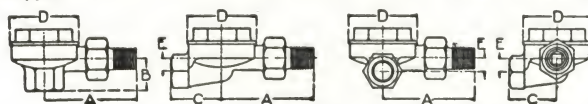


Fig. 806A. Traps Nos. D4 and D5



Angle Pattern Straightway Pattern Right Hand Pattern

Traps Nos. D1, D2 and D3

(Dimensions of Left Hand Pattern are the same as those of the Right Hand Pattern)

Fig. 805

Float and Thermostatic Traps

These traps quickly handle large volumes of water on sudden calls for maximum duty. They open automatically for water and air and close for steam. The water is handled by the float valve, so constructed that the opening is always sealed with water with no opportunity for steam leakage. The air is



Dunham Float and Thermostatic Trap "D" Series

Trap No.	Size of tapping, in.	Capacity sq. ft. equi. direct rad.	Net wt. lb.	Dimensions, in.							Code
				A	B	C	D	E	F	G	
D22	3/4	1600	14	11 1/4	6 3/8	9 1/4	1 5/8	3 1/4	3/4	5 1/2	Debloater
D23	1	2800	15	11 3/4	6 3/8	9 1/4	1 5/8	3 1/4	3/4	5 1/2	Deblockade
D16	3/4	3600	24	14 3/8	7 7/8	10 1/2	1 3/8	4 1/4	1 1/2	7 7/8	Deblare
D17	1	5200	24	14 3/8	7 7/8	10 1/2	1 3/8	4 1/4	1 1/2	7 7/8	Deblazon
D18	1 1/4	8000	33	15 1/2	9 5/8	12 1/2	2	4 7/8	1 3/4	9 1/2	Deblest
D19	1 1/2	10000	33	15 3/4	9 5/8	12 1/2	2	4 7/8	1 3/4	9 1/2	Deblithe
D20	2	14000	42	19 3/4	11 1/8	15 1/2	2 1/4	6 7/8	1 3/8	9 3/8	Deblink

Capacities given are based upon a condensation rate of 1/4 lb. per sq. ft. of cast iron direct radiation per hour, at a pressure differential of 1 in. of mercury, which is equivalent to 1/2 lb. per sq. in. All traps have right hand female tappings.

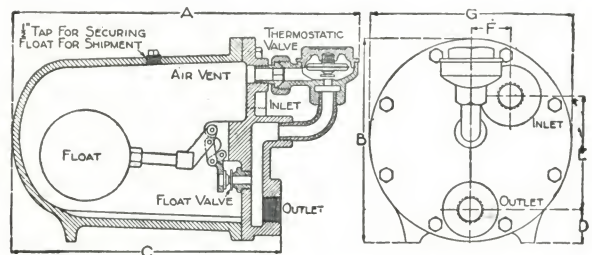


Fig. 1161A. Traps Nos. D16, D17, D18, D19 and D20

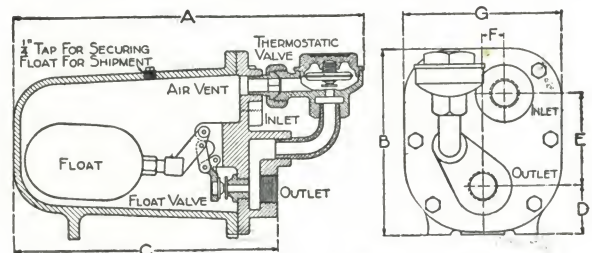


Fig. 1162A. Traps Nos. D22 and D23

handled by the thermostatic valve. They combine the Dunham Thermostatic Valve Principle with the float. The "D" Series Traps are specially made for the Differential Vacuum Heating System.

Note: For other types of Dunham Float and Thermostatic Traps, see Dunham pages 43, 44.

DUNHAM DIFFERENTIAL SYSTEM (Continued)

Pipe Sizes for Differential System and Capacities and Dimensions of "D" Pumps

Pipe Sizes

The tables show steam mains and steam risers slightly larger than a Vacuum Return Line System, because of the larger volume of steam to be circulated in mild weather, although a smaller weight of steam is circulated. Ample grade of all pipes must be provided to insure free circulation. *Experience proves that a Differential System using vacuum return line pipe sizes will secure a fuel saving up to 25% over vacuum return line operation. Experience also proves that a system using Differential pipe sizes will secure fuel savings from 25% to 40% or more.*

Drips

The steam mains are dripped direct to boiler return header



and drip mains vented through a "D" Series Trap to the return main on systems operating without reducing valves. The pressure in the boiler, radiators and supply piping will be the same, permitting condensate to enter boiler. Should a higher pressure be carried in boiler than in the system (where Reducing Valve is used for admitting Sub-atmospheric steam into the system) then "D" Series Float and Thermostatic Traps must be used on mains and connected to returns leading to Differential Pump. The same applies when steam piping is too low for gravity return to boiler. No lift connections can be used.

TABLE 15. STEAM MAINS

Pipe sizes, in.	Capacities in square feet of direct cast iron radiation for each length									
	*Length of runs in feet									
	100	200	300	400	500	600	800	1000	1500	2000
2	820	580	470	420	370	330	290	260	220	180
2½	1530	1070	880	770	670	610	540	470	400	340
3	2780	1940	1580	1380	1220	1110	970	860	720	600
3½	4400	3080	2510	2200	1940	1760	1530	1360	1140	970
4	6200	4320	3520	3120	2720	2480	2160	1920	1600	1360
5	11000	7730	6240	5520	4880	4400	3840	3440	2880	2430
6	17750	12400	10200	8800	7850	7130	6240	5520	4560	3920
8	41400	28800	23600	20700	18400	16600	14500	12800	10800	9100
10	72600	51000	41400	36200	32000	29000	25400	22500	18900	15900
12	114000	80000	65300	57200	50400	46000	40000	35400	29700	25200
14	148000	104000	84200	73800	64900	59000	51600	45900	38300	32500
16	210000	148000	120000	105000	92700	84000	73800	65400	54900	46400

TABLE 16. RETURN MAINS

Pipe sizes, in.	Capacity in square feet of radiation									
	1	1¼	1½	2	2½	3	3½	4	5	6
* 400 ft.	800	1600	4000	11000	21000	38000	55000	78000	138000	220000
* 1000 ft.	500	1000	2500	7000	13000	23500	34000	48000	86000	138000
* 2000 ft.	350	800	1800	5000	9000	16000	24000	34000	60000	98000
* 3000 ft.	300	600	1500	4000	7500	13500	20000	28000	50000	80000

TABLE 18. RISER SIZES

Pipe size, in.	Capacity in square feet of radiation									
	Supply								Return	
	¾	1	1¼	1½	2	2½	3	3½	4	5
* 200 ft.	40	80	174	270	550	905	1600	3080	4320	1000
* 400 ft.	28	57	126	195	392	650	1140	2200	3120	800
* 600 ft.	23	46	99	156	315	520	912	1760	2480	640
* 1000 ft.	18	35	77	120	246	402	708	1360	1920	500
* 2000 ft.	12	25	55	86	174	285	498	968	1360	350

TABLE 17. STEAM MAIN DRIPS

Pipe sizes, in.	1¼	1½	2	2½
Capacity in sq. ft.	1000	2000	4000	6000

TABLE 19. RADIATOR CONNECTIONS, TOP INLET
Valve Types 105 or 145 with Regulating Plates

Square feet of direct radiation	Supply			Return		
	Size inlet valve, in.	Vertical pipe to inlet valve, in.	Horizontal runout to riser, or spring piece to main from a first floor radiator, in.	Trap No.	Stub to trap and size of trap, in.	Horizontal runout to riser or first floor radiator, in.
1-25	½	½	¾	D1	½	¾
26-80	¾	¾	1	D1	½	¾
81-100	¾	¾	1¼	D1	½	¾
101-140	¾	¾	1¼	D2	½	¾
141-170	¾	¾	1½	D2	½	¾

TABLE 20. ALLOWANCES FOR RESISTANCE TO FLOW
In Feet of Pipe

Pipe size, in.	¾	1	1¼	1½	2	2½	3	3½	4	5	6	8	10	12	14	16
For elbows.	2	2	2	3	5	6	9	10	14	19	24	35	47	59	70	82
For globe valves.	2	3	3	5	7	9	14	15	21	28	36	53	70	88	106	124

*In sizing pipes the length of the piping must be ascertained and the frictional resistance of fittings and valves considered. It is customary to reduce the resistances to equivalent length of straight pipe, which must be added to the actual length. In table 20 these resistances are given in feet of pipe.

The length equals the distance along piping from source of supply (boiler or reducing valve) to the top of the riser, plus allowance for elbows, valves (Table 20) and plus 25 ft. allowance for last radiator connection.

Do not reduce any steam main below 2 in. in size at its end.

Spring pieces, that is, connections from steam main to riser must always be made one size larger than the riser. Make return spring pieces same size as return riser.

Use pipes two sizes larger than vertical pipe for supply spring-pieces, and radiator runouts over 8 ft. long.

This data is thoroughly reliable if properly used.

Our engineering department is available for the checking of plans.

Capacities and Dimensions of "D" Series Dunham Differential Vacuum Pumps

These pumps are for use on "D" Series Dunham Differential Heating Systems only and are specially built for this purpose. Do not specify "D" Series Pump for any other system.

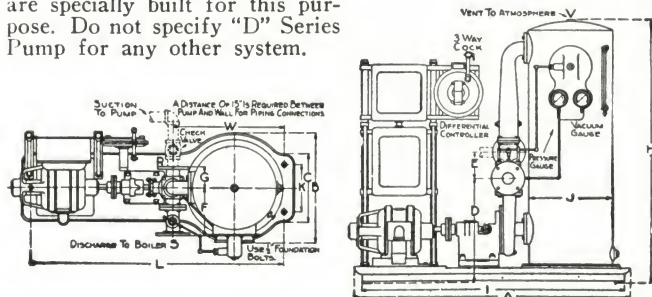


Fig. 1289

CAPACITIES AND DIMENSIONS STANDARD DIFFERENTIAL PUMPS

No. Rated ...	D3		D8		D16		D26		D40		D50	
	3000	8000	16000	26000	40000	50000	Any current	Any current	Any current	Any current	Any current	Any current
Kind of electric current	Any current	Single phase	2 or 3 phase or d-c.	2 or 3 phase or d-c.	Single phase	2 or 3 phase 50-60 cycle or d-c.	2 or 3 phase 25 cycle single phase or d-c.	Any current	Any current	Any current	Any current	Any current
Hp.	1	1½	1½	2	2	3	3	5	7½			
A	60¾	63¾	60¾	60¾	63¾	60¾	63¾	66¾	81¾			
B	24	24	24	24	24	24	24	26	30			
C	15	18½	15	15	18½	15	18	19¾	22			
D	21½	21½	21½	21½	21½	22¾	22¾	23½	25½			
E	5½	4½	4½	4½	4½	5½	5½	5½	5½			
F	8½	8½	8½	8½	8½	10½	10½	11½	14½			
G	3½	3½	3½	4	4	4½	4½	5½	6			
H	46	46	46	52	52	58	58	58½	62½			
I	57¾	61¾	57¾	57¾	61¾	57¾	61¾	64¾	79			
J	18	18	18	18	18	18	18	20	24			
K	10¾	14¾	10¾	10¾	14¾	10¾	14¾	15¾	17			
L	55¾	59	55¾	55¾	59	55¾	59	62	76¾			
R	1½	1½	1½	2	2	2½	2½	3	5			
S	1½	1½	1½	2	2	2½	2½	3	5			
V	1	1	1	1	1	1½	1½	1½	1½			
W	25½	25½	25½	25½	25½	25½	25½	26½	34½			

DUNHAM DIFFERENTIAL SYSTEM (Continued)

Installation of Accumulator Tank, Lift Connections and "D" Series Pump Connections

Accumulator Tank

The accumulator tank must be the low point of the system, with returns grading toward and into the inlet of tank.

The location of the accumulator tank is also important in relation to the suction of the pump. Wherever possible the accumulator tank should be installed so that its outlet tapping is slightly

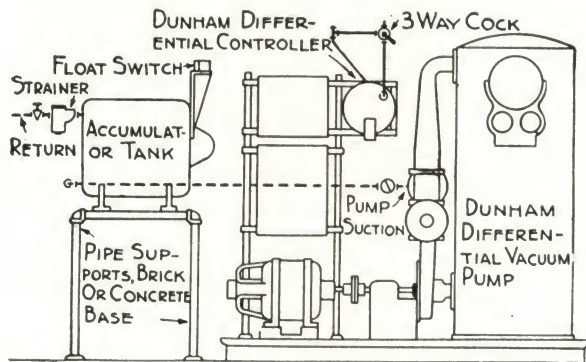


Fig. 1180



above the pump suction, that is, so the condensate can flow by gravity from the accumulator tank to the pump. See Fig. 1180.

Where this is not feasible the tank should be placed as high as possible, so as to keep the lift at a minimum. It requires approximately 1 in. of vacuum for each foot of lift. By keeping the lift at a minimum the amount of vacuum used to lift the water is also kept to a minimum with a higher vacuum available for the system.

Accumulator Tank and Strainer are furnished with "D" Series Pumps.

ACCUMULATOR TANK TAPPING SIZES AND STRAINER SIZES AS FURNISHED WITH "D" SERIES PUMP

Size of pump	Size of accumulator tank, in.	Accumulator tank tappings		Size of pump discharge, in.	Size of strainer, in.
		Inlet, in.	Outlet, in.		
D3	18x18	2	1½	1¼	2
D8	18x18	3	1½	1½	3
D16	18x24	3	2½	2	3
D26	18x36	4	2	2½	4
D40	18x36	4	3	3	4
D50	18x36	5	3	3	5

Tested check valves are furnished for both suction and discharge of pump and vent from accumulator tank and receiver tank. Strainer is furnished.

Lift Connections

These must not be used in Differential Systems, except between Differential Pump and Accumulator Tank. An extra lift connection is required at the tank when distance of lift becomes greater than 4 ft.

As an example assume that there is an 8-ft. height from the Accumulator Tank outlet to the Pump Suction. Break up this vertical distance into two lengths placing a lift pocket in the middle, because in this manner with the pump running under normal operating conditions it is possible to lift the water from the accumulator tank to the pump suction with less vacuum than would be required by using only one straight lift pipe.

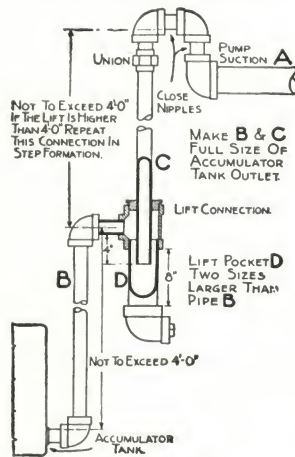


Fig. 1181

By normal operating conditions we mean—when the pump is pulling a vacuum on the system and the accumulator tank is being kept fairly dry.

Under these conditions there is not a solid column of water in the entire lift pipe, it being broken up with slugs of air between slugs of water; as the slug of water comes over into the lift fitting half way up the lift pipe the total work is reduced. The vacuum energy not being used in lifting the water is then available to create a higher vacuum in system which again gives lower fuel cost.

See Dunham Page 47 for Data on Dunham Lift Fittings.

Installation of "D" Series Pump and Pump Connections

The pump should be placed on a solid concrete foundation extending from 3 in. to 6 in. above boiler room floor. Make pipe connections substantially as shown by installation details shown in Fig. 1183.

Do not connect to the Differential Vacuum Pump any return mains from hot water heaters, or other equipment carrying higher steam pressure than that carried in the Differential System as this would reduce the pump efficiency.

The Differential Vacuum Pump maintains a difference in pressure between radiators and return piping and circulation of steam to radiators. When pump is in operation, pressure gauge "A" should indicate about 20 lb.

Condensation gravitates into Tank "E" and is drawn by Pump through check valve "F" and discharged into Tank "B." Float in Tank "B" rises and permits valve "C" to return condensate to boiler through check valve "G" (or open receiver when high pressure boilers are used). Air is released through air check "H" above Tank "E" and check "I" on Tank "B."

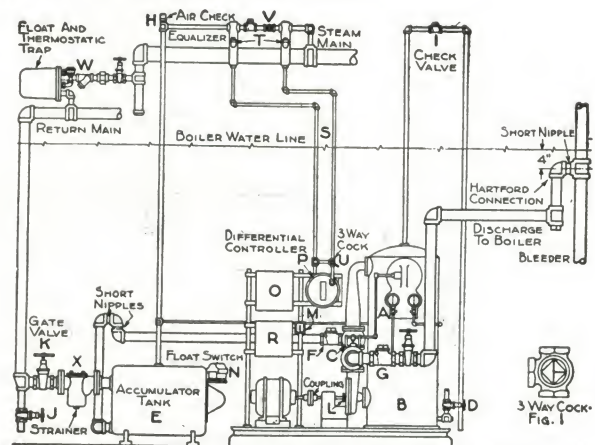


Fig. 1183. "D" Series Pump and Connections

DUNHAM DIFFERENTIAL SYSTEM (Continued)

Type "D" Series Zoning—Individual Temperature Control for Sections of Buildings or Groups of Buildings

By "zoning" is meant the division of a heating system into smaller complete units for the purpose of separate control to secure lower operating costs.

Different parts of buildings require different quantities of heat at different times due to class of occupancy of various parts of building, sun and wind effect on the different sides, and buoyancy of the heated air as in very tall buildings. Therefore, all large buildings should be "zoned" to secure maximum conservation of steam and correct heating of all sections.

The Dunham Zone Temperature Control in conjunction with the Dunham Differential Vacuum Heating System, see Fig. 1247B, Dunham Page 14, provides remote electrical control of the steam supply as required by each zone.

General Description of the System

Each zone operates from its own thermostat located at a suitable control point or "key-room." Furthermore each zone must be served by its own Differential Pump where the building is divided into two or more independent zones.

Note: For small buildings and change-over jobs control can be obtained by two or more thermostats operating with a single Differential Pump in conjunction with Alternate Control Panel described on Dunham Page 20.

A building may be divided into any number of zones but an average size building could conveniently be divided into two zones—one set of piping caring for the west and south sides, the other set for the north and east sides. Usually in ordinary heating, Duplex Pumps are specified. This, in the Differential System, will allow a pump on each zone. The heating costs will be more uniform and fuel costs less. The illustration below shows a large building divided into four zones. The same theory is applied to groups of buildings—each independently controlled from the boiler room.

Simplicity of Operation

A building is divided into the necessary zones by having each zone supplied from its



own steam main. The supply of steam from each main is controlled by a Dunham Type 377A (electrically operated) Sub-atmospheric Pressure and Temperature Control Valve (described on Dunham Page 21). One or more thermostats are located at the proper points in the zone and set to a predetermined degree.

Automatic Remote Control—When the room thermostat of any zone calls for heat, the sub-atmospheric control valve for that zone opens automatically, allowing more steam to flow into it, producing the required rate of heat transfer from the radiation. When the proper value is reached this additional steam supply is stopped. This operation is repeated whenever required by room temperature conditions.

Manual Remote Control—The control valves for each section being electrically operated can also be remotely controlled independently of the thermostats. A Dunham Zone Control Panel in the boiler room shows the operating engineer at a glance the temperature conditions in the various zones and he can, by simply throwing a switch, accelerate or decelerate the rate of steam flow to the particular zone.

Controlling Factors in Designing a Zoning System

(1) **Buoyancy**—Heated air rises within the building due to flue effect. This causes the upper floors of tall buildings to be overheated after the system is full of steam.

(2) **Exposure**—Sunshine, wind and other weather conditions cause variable heat demands on different sides of buildings.

(3) **Type of Occupancy**—Sections of the same building may require different degrees of heat due to their particular uses, such as storage, manufacturing, office space, etc., or periods of occupancy.

No particular rule can be given for the zoning of a building, each is an individual problem and should be studied carefully.

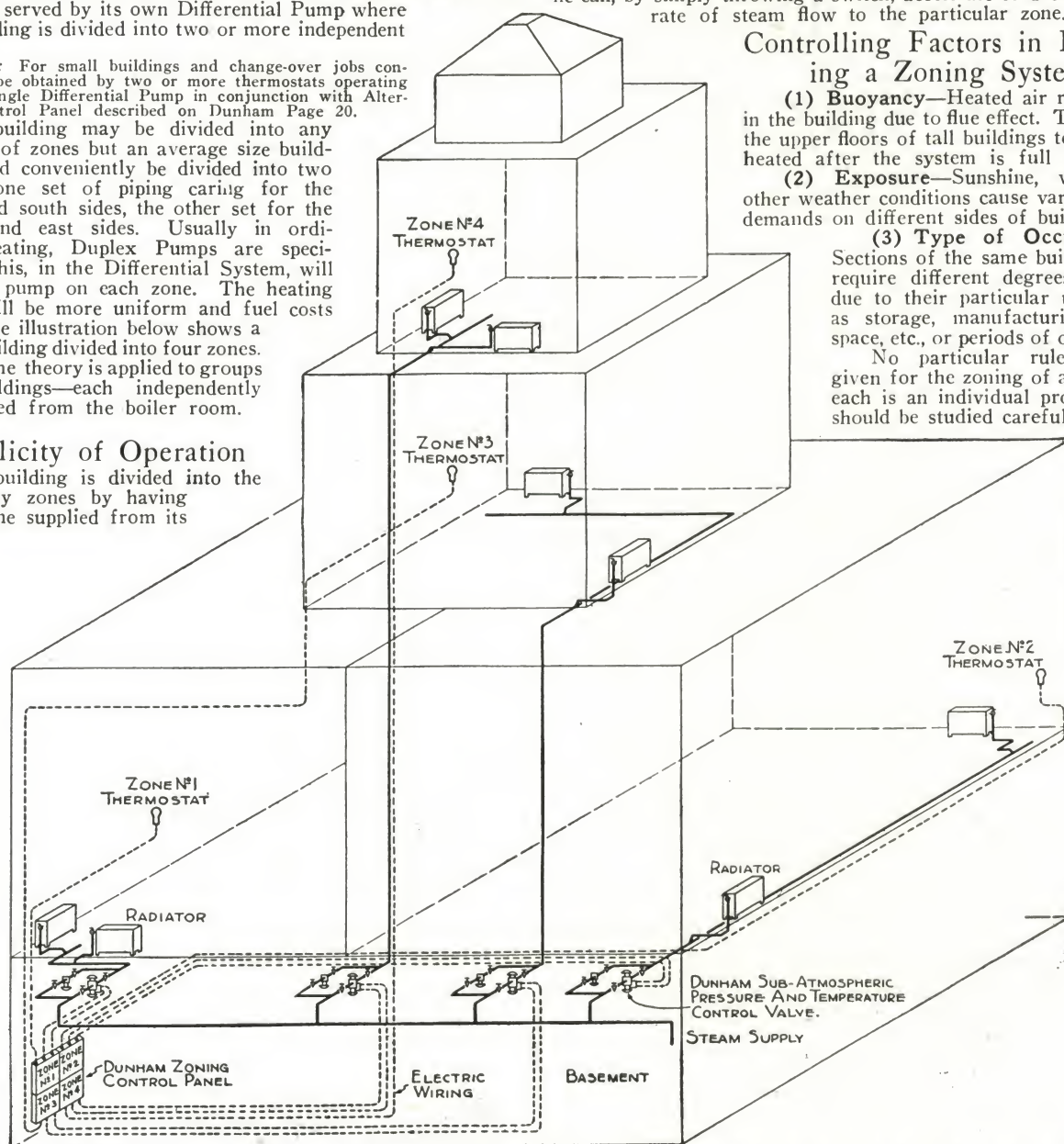


Fig. 1245. Schematic Illustration of a System Equipped with Four Zones (or Sections), with Each Zone Controlled Independently of the Others. This Drawing Does Not Give Actual Piping Details, the Purpose Being to Illustrate the Control System Only—and Not the Heating System

DUNHAM DIFFERENTIAL SYSTEM (Continued)

Types of Control

The system of control is arranged so that:

A single valve may be controlled by a single thermostat.

A single valve may be controlled by several thermostats.

Several valves may be controlled each by its own thermostat.

Several valves may be controlled each by several thermostats.

The control panel in each case is centralized in the boiler room.

Where heating systems are divided into complete zones (or for systems where only one thermostat is intended to control one valve) Control Panel Type 391 is used.

Either control provides the following advantages:

It centralizes control of the entire steam supply.

It permits either automatic or manual operation.

It gives the attendant the information he desires regarding temperature conditions prevailing in various parts of the building, in addition to informing him whether or not the valve is admitting steam to the system.

Each panel is provided with a red and a green light for each thermostat and each valve. Switches are provided for transferring the system from automatic control to manual operation. Each thermostat has a switch to permit its being disconnected from the control.

A line switch is also provided on the control panel to disconnect the entire control system from the electric supply line.

When the operating element of a thermostat is in "cold" position the motor of the valve operates to open valve and causes red signal lights for this circuit to show. When the valve has opened, the light indicating the position of the valve also shows red, this indicates that steam is being called for. The increased supply of steam to the system results in a rise of the temperature of the building. The thermostat responds when sufficient heat has been supplied and causes the red light (indicating the temperature condition at the thermostat) to be extinguished and the green light to show. Simultaneously the motor operates, closing the valve. When the valve has closed, the signal light for the valve will show green, the red light being extinguished.

Signal Lights—The signal lights are standard 2 C.P. 125 volt Candelabra base lamps which may be secured from any electrical supply station. To remove and replace a lamp, it is only necessary to remove the two screws holding the "jewel"

cover plate, then pull lamp forward and unscrew it from its socket, screw in the new light and then push it back and replace the plate.

Relays—The relays are located behind the relay cover plate so the contacts are accessible from the front. Two screws hold the relay cover plate.

The terminals for the wires from the thermostats and the motor are at the bottom of the cabinet, and final connection may be made through the opening provided. Two screws hold the terminal cover plate. The terminals are clearly marked for connecting the wires.

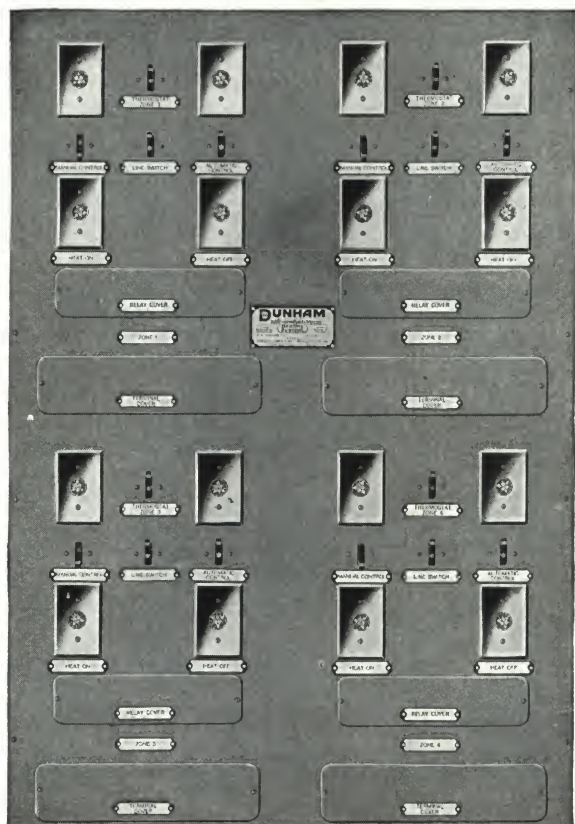
Installation of Control Panel—The leads are brought into the cabinet, a sufficient length being left so that each can be connected to its terminal through the terminal cover.

Zone Control Panel—The Zone Control Panel Type 391, enables the engineer to know the temperature conditions in the building, and regulates by zones the temperature in the various parts of the building in proportion to the weather conditions, sun and wind effect or for period of occupancy. Each zone has supply and return piping independent of the other zones. The Type 377A valve in the supply to each zone, is controlled by the thermostat located in that zone, through the control panel located in the boiler room, all being connected by electric wiring.

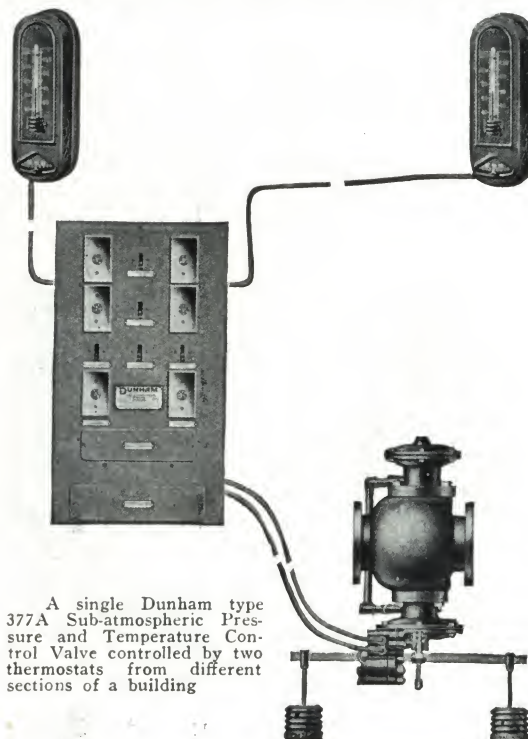
The Zone Control Panel is equipped with lights which indicate to the engineer the heat condition in the zone. Green light indicates the zone is at the desired temperature, a red light, that additional heat is required. Another set of red and green lights indicates whether the Type 377A valve is supplying the additional steam or is closed.

Alternate Control Panel—The Alternate Control Panel, Type 390, enables the engineer to know temperature conditions in the building and to regulate the temperature in various parts of the structure. The application is similar to "Zoning" (described on Dunham page 19) and is recommended for systems that cannot be readily divided into separate zones. The piping arrangement may not permit this ideal, complete division, but the medium size building and the change-over installation may have the benefit of control through this Control Panel in conjunction with Type 377A Sub-Atmospheric Pressure and Temperature Control Valve.

The panel is located in the boiler room and is connected by electric wiring to Type 377A Valve. It is also connected to two or more thermostats, located at different points of the building (to obtain heat control of the coolest part, depending upon wind and sun effect upon the building). The panel is equipped with lights which indicate to the engineer the heat conditions in the building—a green light is shown when the thermostat indicates proper temperature and a red light flashes



Type 391 Four Zone Control Panel



A single Dunham type 377A Sub-atmospheric Pressure and Temperature Control Valve controlled by two thermostats from different sections of a building

Alternate Control Panel Type 390

DUNHAM DIFFERENTIAL SYSTEM (Continued)

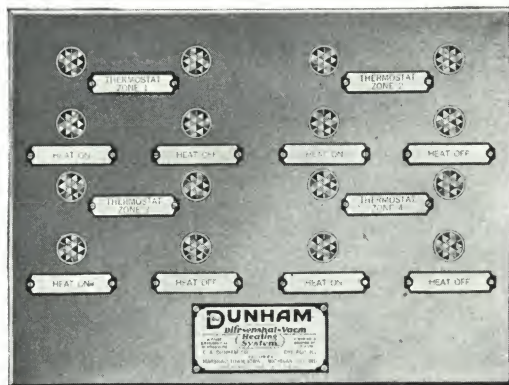
when the thermostat is below this temperature. Any thermostat calling for heat automatically takes charge of the heat supply. The panel is also provided with switches for obtaining manual control.

The equipment is mounted on a blue enamel metal panel box. The function of each switch is given on an etched zinc name plate. The "jewel" plates are polished nickel.

Type 392 Signal Panel for Superintendent's Office

When desired a Signal Panel can be provided to be located in the building superintendent's office enabling him to observe temperature conditions and operation of the temperature controlled valves in the various zones.

This panel will indicate simultaneously with the panel in the boiler room the range of temperature existing in the building and the position of the temperature controlled valves.



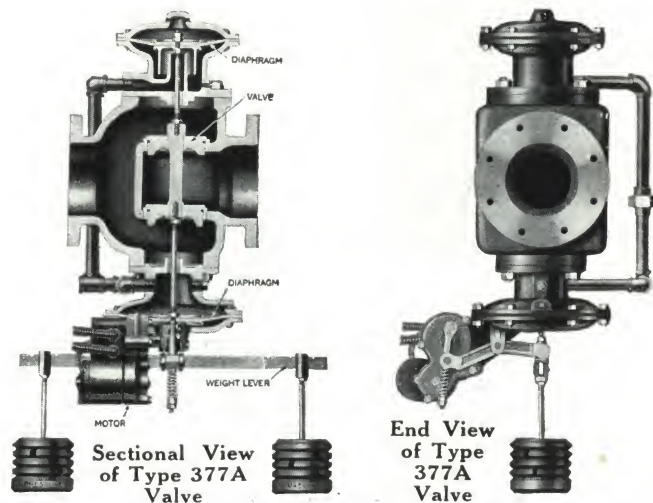
Type 392 Signal Panel

Sub-atmospheric Pressure Reducing Valves

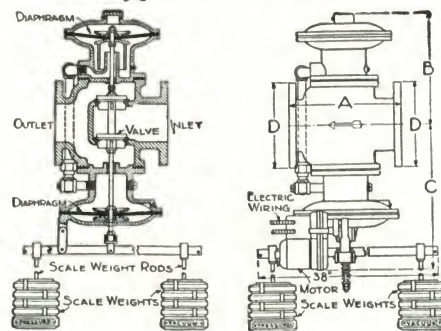
Type 377A Valve is used in connection with a Type 375A Valve and is controlled by one or several thermostats. The method of piping is shown by Fig. 1246B Dunham page 14. Where the steam is supplied at a pressure greater than ten pounds a reducing valve is used between boiler and the sub-atmospheric pressure reducing valves to reduce boiler pressure to about two pounds gauge. The Type 375A valve supplies the steam required by mild weather. As the weather becomes colder necessary additional steam is supplied by valve 377A in response to the thermostat's operation.

Type 377A Valve—This valve is motor operated, controlled from one or more room thermostats, otherwise it has the same design and construction as the valve Type 375A (see Dunham page 15). It is used in place of valve "B" when automatic control is desired.

The motor is a universal type requiring 110 volts d-c. or a-c. 25-60 cycle current. Wiring diagram is furnished with valve.



Type 377A Valve



Notes:

Valves are all standard flange. Operating range: Minimum initial pressure, 10 lb.; reduced 25-in. vacuum.

Install valve to permit access to scale weights. Extend scale weight rod by means of 1/8-in. pipe to within 6 ft. from floor. Capacities of this valve are same as for Type 375A given on Dunham page 15 in this catalogue.

Type 377A Sub-atmospheric Pressure and Temperature Control Valve
Standard flanged connections only

Pipe size, in.	Approx. ship. weight, lb.	Code	Dimensions in inches			
			A	B	C	D
2	240	Arrowmo	8 3/8	10 1/8	15	6
3	275	Arroheadmo	10 1/4	12 1/8	16	7 1/2
4	340	Arroootmo	12	12 3/8	16 3/8	9
6	525	Arroyomo	15 1/2	15	19	11
8	695	Arsacidmo	19	16 3/4	20 1/2	13 1/2
10	810	Arsenalmo	19 1/2	18 3/4	22	16
12	890	Arsenicmo	26 1/2	20 1/8	24	19
14	960	Arsenidemo	30 3/8	22 1/4	26 1/2	21

Thermostats and Their Location

The thermostats operate at 20 volts. The use of low voltage thermostats permit the wires to be run in conduits provided for other low voltage apparatus (if in keeping with local ordinances). It also makes possible the thermostat cables being run on the baseboard wherever other means are not provided.

The thermostat should be located in a "Key-Room" representing the average temperature requirements and at the most exposed point in the zone or building. It should be installed on an inside wall 5 ft. from the floor line. The "Key-Room" should have exposure and radiation. To determine the proper location of "Key-Room," study the particular conditions of the building.

No particular rule can be laid down but the following schedule will serve as a guide:

1. *In a residence* locate thermostat in an important living room (not closely exposed to effect of radiant heat from fireplace or radiator), preferably near end of steam main but not directly over boiler room.

2. *Small Apartments, Stores and Apartments.* Locate in a heated hall or other large room where janitor has control of radiators. Thermostat should be set for a hall temperature that will obtain when building temperature is maintained at 70°. Radiators in "Key-Room" should be equipped with lock and shield valves.

3. *Large Apartments, Hotels and Office Buildings.*

(a) Locate in heated hall or large lobby or building manager's office.
(b) Use one or more thermostats with switch arrangement. Locate thermostat at central points "Key-Rooms" where wind exposure or sun may affect heat losses from building.

(c) Where several wings are encountered, a thermostat should be located in each wing and a suitable switch arrangement provided so that only one thermostat (the one on coldest exposure) will control the building temperature at any one time.

Set thermostats for temperatures that will obtain in their respective locations when building temperature is maintained at 70°. Radiators in "Key-Rooms" should have lock and shield valves.

4. *Factories, Warehouses and Garages.*

(a) Locate in an office or salesroom having exposure and radiation. Set thermostat to maintain a room temperature at point of location which will give desired temperature in the rest of building.

(b) On interior column, or partition, near most exposed side of building.

5. *Churches.* Locate in room most suitable, depending upon piping design, use of rooms, etc.

6. *Schools.* Locate in main study hall, using lock and shield valves on radiators.

7. *Hospitals and Like Institutions.*

(a) Locate in business office for small building. Set thermostat to maintain the room temperature at point of location which will give desired temperature in the rest of building.

(b) On large installations zoning is advisable. Locate thermostats in each of the several wings or zones so that they will control building temperature.

8. *Up Feed System.* The location of the thermostat should be in a room giving average conditions and on side influenced most by wind exposure.

9. *Downfeed System.* The thermostat should preferably be placed on the lowest floor supplied by the downfeed system.

10. If "Zoning" or "Alternate Control" is adopted, install thermostats in suitable location for controlling heat for each "zone."

DUNHAM DIFFERENTIAL SYSTEM (Continued)

Heating Specifications "D" Series, Dunham Differential Vacuum Heating System

(1) **General Conditions**—The general conditions governing this work shall be those established as standard by the American Institute of Architects which shall apply hereto.

(2) **Construction and Material**—The heating apparatus, proposed herewith includes the furnishing, delivery and erection on the premises of all necessary material and labor, which shall be first class in all particulars, and in accordance with the specifications and plans.

(3) **Inspection**—The Heating Contractor must at all times allow the C. A. DUNHAM COMPANY's Representative to come on the job for the purpose of inspection and must lend any assistance necessary to expedite and complete the work. Any instructions given by the C. A. DUNHAM COMPANY's Representative and confirmed in writing regarding changes to make system conform to plans or specifications and details shall be considered a part of this specification.

(4) **Boiler**—The steam boiler shall be a.....with guaranteed rating for.....sq. ft. of radiation installed upon suitable foundation, and equipped with all necessary connections and trimmings, including a safety valve set to blow at 10 lb. pressure, a Dunham Compound Gauge 15 lb. x 30 in. vacuum and a 7-in. Dunham Damper Regulator. (Omit Regulator on gas fired and automatic oil fired installations.)

(5) **Smoke Pipe**—Connect boiler to chimney with suitable black iron smoke pipe gauge..... Size to be as recommended by Boiler Manufacturer. Smoke pipe must be provided with hand stop damper. (Omit stop damper on gas fired installation.)

(6) **Pressure and Temperature Control**—On all systems not equipped with full automatic control of fire, install Dunham Sub-Atmospheric Control Valves of size shown on plans, with necessary gate valves. Install Dunham 15 lb. x 30 in. compound gauges where directed. If Thermostats and Dunham Control Panels are to be used, Heating Contractor shall furnish, install and wire these, all in accordance with manufacturer's details and instructions.

(7) **Pipe and Fittings**—Furnish and erect with tight connections all necessary piping of sizes shown on plans and run as indicated, supported and properly graded to insure free and noiseless circulation. Use fittings of cast iron of standard quality. The ends of all pipes shall be reamed or filed. Proper provision must be made for expansion. Use graphite and oil for making up all pipe joints applied to male thread only. Provide for expansion of mains and risers by loop type expansion joints and swing connections in mains wherever possible. In other cases provide approved all-metal packless expansion joints. Piping to be properly anchored.

(8) All steam tappings in boiler shall be connected full size of tapping into a steam header which shall be dripped to the return header through a bleeder. All spring pieces to steam and return mains shall be taken off the top of mains at 45 degrees. On down-feed systems, take the spring pieces from the bottom of steam main at 90 degrees.

(9) The end of each steam main and each drip point shall be drained, through a gate valve, Dunham Strainer, and "D" Series Dunham Trap as indicated on plans.

No lift connections shall be used at drip points.

(10) Grade steam mains, return mains and drip mains $\frac{1}{2}$ in. in 10 ft. All steam supply branches such as spring pieces, offsets in steam risers and runouts to radiators shall in each case be installed one size larger than the vertical pipes to which they connect and shall be given as much grade as possible $\frac{1}{2}$ in. per ft. is preferable.

(11) Return mains shall be connected together into the accumulator tank of Dunham Differential Vacuum Pump as shown in detail furnished by manufacturer. Lift connections must not be used except between pump and accumulator tank.

(12) Risers are to be run concealed or in the open as directed by the architect. Each down-feed steam riser must be dripped into the return through a "D" Series Dunham Trap. Install traps as instructed by manufacturer. All concealed piping must be tested and made tight at 15 lb. water pressure before being concealed and covered.

(13) All union connections, flanges, packing nuts on gate and globe valves and on gauge glass of boiler must be drawn up tight so as to prevent air leaking into system when under a high vacuum. This work must be performed after system is completed and while it is working with a vacuum in both steam and return lines.

(14) **Floor Plates, Sleeves**—Furnish approved floor and ceiling plates, protecting sleeves on all pipes passing through floors or finished partitions.

(15) **Differential Vacuum Pump**—Furnish and install one or several (as indicated on plans) Dunham Differential Vacuum Pumps of "D" series size..... having a differential rating of..... sq. ft. of equivalent direct radiation. The pump (or pumps) shall be installed, connected and wired in accordance with manufacturer's instructions and local regulations.

(15A) **Domestic Hot Water and Blast Heater**—Condensation from this equipment shall be returned to boiler by other means than Dunham Differential Vacuum Pump.

(16) **Check Valves**—Check valves shall be horizontal swing type with brass disc, best grade obtainable. They shall be installed where called for by the plans, and in accordance with accompanying details. They shall be tested for tightness.

(17) **Radiation**—Furnish and install radiation as shown on the plans. There shall be.....sq. ft. of direct radiation of approved make. All radiators must be provided with top inlet tapping. Furnish $\frac{1}{2}$ -in. eccentric bushing in the return tapping. All air valve tappings shall be plugged.

(18) **Radiator Traps and Valves**—Each radiator shall be provided with a Dunham "D" Series Radiator Trap of suitable capacity. A Dunham Packless Radiator Valve with Dunham Regulating Plate shall be installed at inlet connection according to manufacturer's instructions.

(19) **Painting**—All exposed piping in finished rooms shall be given a priming coat of flat paint and thereafter painted or enameled as directed by architect. Radiators shall be painted as directed by architect. All pipe joints and all uncovered piping in basement, front and other exposed parts of boiler shall be painted one coat of black asphaltum when the system is hot and under a vacuum. The finishing coat of paint must be applied when the entire system is under vacuum, so that paint will fill up small leaks.

(20) **Covering**—Cover all steam mains and spring pieces with four-ply, 1 in. thick asbestos sectional covering and fittings with asbestos cement. Cover all steam and return risers and other piping run concealed in outside walls with two-ply, $\frac{1}{2}$ in. thick asbestos sectional covering. Cover boiler as specified by boiler manufacturer.

(21) **Finishing Up**—After system has been in operation two weeks, thoroughly blow down and clean out system as follows:

Remove the safety valve and connect a temporary blow-off pipe to the safety valve tapping, extending it outside or to some suitable drain. Shut off all radiator valves or valves in main. Fill the boiler with water to top of gauge glass. Build a very hot fire and blow steam and water out through the safety valve tapping and pipe connected thereto. Fire hard with not more than 10 lb. pressure on the boiler. Supply cold water constantly in at bottom of the boiler. Continue this for six hours. At the end of the period, close the water feed valve, draw the fire quickly, open blowoff at bottom of boiler and entirely drain the boiler, replace the safety valve. Fill the boiler slowly after it becomes cold.

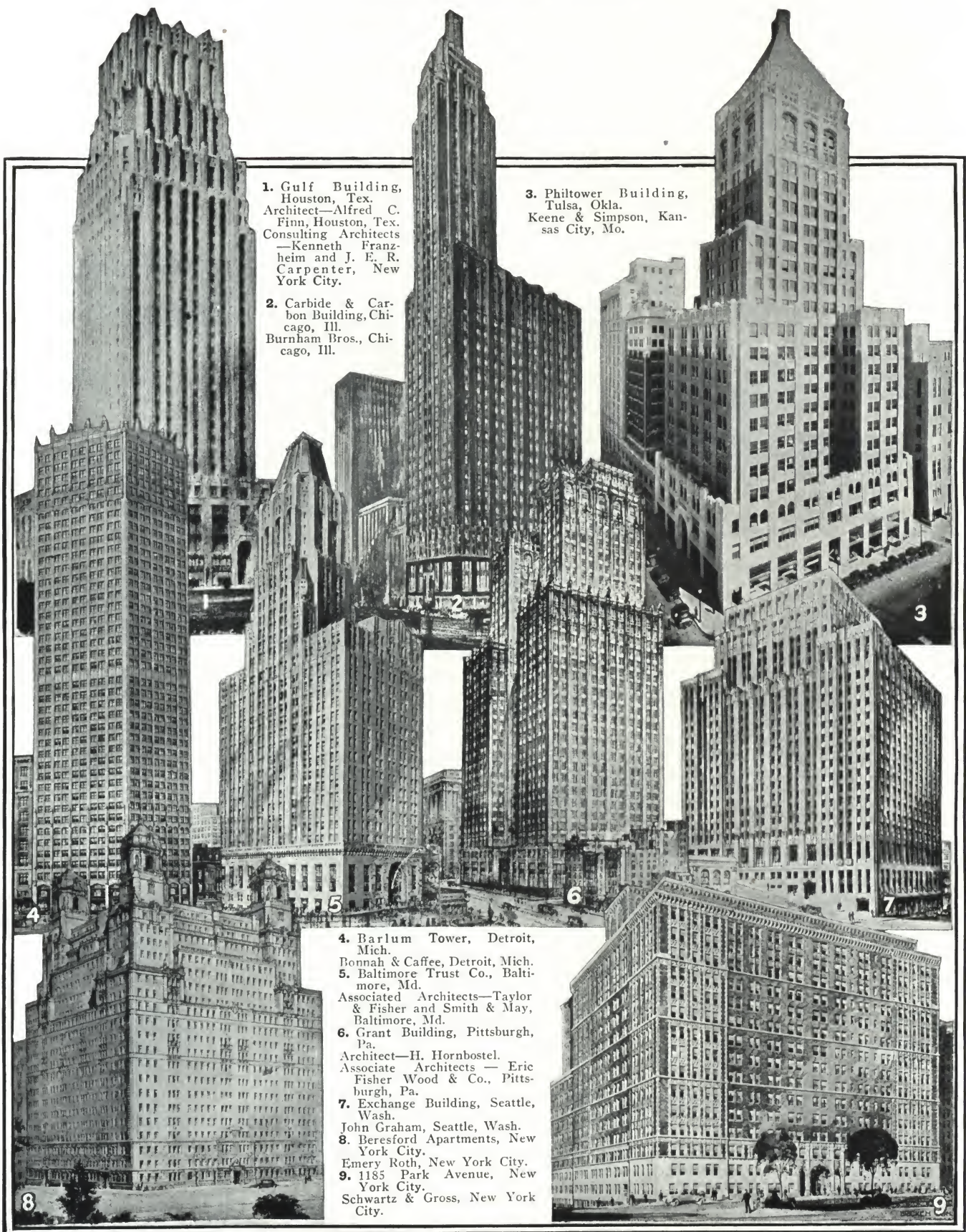
Remove the cover of each trap and wipe off grease and dirt accumulation. Replace trap cover tightly on body.

(22) **Test**—The System when finished and cleaned shall be tested for tightness as directed by C. A. DUNHAM COMPANY's Representative. Contractor shall furnish labor and material for performing test.

(23) **Guarantee**—The Heating Contractor shall guarantee the apparatus installed to circulate steam thoroughly through every radiator without noise, with a vacuum of 15 in. in steam main. If the apparatus shall fail to accomplish this guarantee by reason of any defect developing within the period of one full heating season and that defect is due to faulty material or poor workmanship, the Heating Contractor shall remedy such defect at his own cost within reasonable time after notice thereof.

(24) **Finally**—Nothing herein contained can be construed to relieve the Heating Contractor from making good and perfect work in all usual details of construction, and he will be held responsible to provide and furnish necessary material and to perform all necessary labor and to bear all expenses incidental to the satisfactory completion of the work.

A Few of the 800 Buildings Which Are Effecting Substantial Savings in Fuel and More Comfortable Heat Through the Dunham Differential Vacuum Heating System



DUNHAM DIFFERENTIAL SYSTEM (Continued)

“DH” Series for Installations Up to 3,000 Sq. Ft. of Radiation—Entirely Automatic

The “DH” Series is for small installations with gravity returns to boiler having a total equivalent direct radiation load of not more than 3000 sq. ft. (excluding piping.) It is entirely automatic in operation.

This system will heat properly any residence or small building without the usual fuel and heat waste caused by overheating and resultant excessive window ventilation. It furnishes steam to the radiators at sub-atmospheric pressures with correspondingly low radiator temperatures, causing a uniform, mild and healthful heat to be distributed throughout the building. This gives the occupants a comfort heretofore unknown, with healthier living conditions.

In most severe weather the steam can be furnished at, or above, atmospheric pressure.

A relatively fixed differential is maintained between the radiator and return pressures; this insures the radiators heating evenly. Economical operation is the natural result of such performance. The system is simple in design, durable and exceedingly flexible to meet varying weather conditions. The outstanding feature of economy of operation is accomplished by:



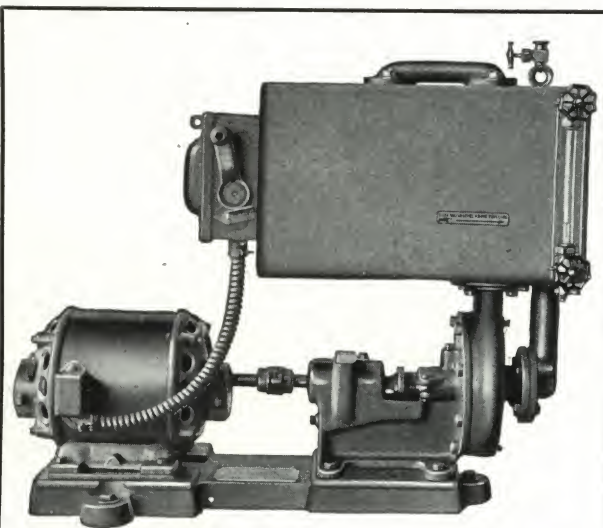
(1) Regulating the amount of pressure, or the degree of vacuum, at which the steam circulates in the supply piping and radiators.

(2) Controlling the vacuum in the return piping so that a substantially constant difference is maintained between the radiator and return piping pressures.

Operation

When the system starts up initially cold, the room thermostat starts both the fire and the Differential Vacuum Pump.

With the system cold the radiator traps will be opened and the vacuum created by the pump will be carried through the return piping, radiators and steam piping to the boiler. Vaporization will start in the boiler and steam will be circulated to the radiators at a lower temperature than if the boiler was at atmospheric pressure (see Dunham page 8). The pump continues to function until the desired room temperature is reached, when it is stopped by the thermostat. In mild weather the heat demand will be small, requiring higher vacuums and lower steam tem-



Dunham Differential Vacuum Pump, “DH” Series

Differential pump No.	Cap., sq. ft. direct rad.	Motor horse power	Ship. wt., lb.	Pipe tapping in.	Dimensions (in.) (see drawing on next page)					
					A	B	C	D	E	F
DH2A	2000	1½	300	1½	26⅞	14⅝	5⅞	4⅜	20⅞	30⅞
DH3	3000	¾	350	¾	29⅞	16	6⅝	4¼	23⅞	33⅞

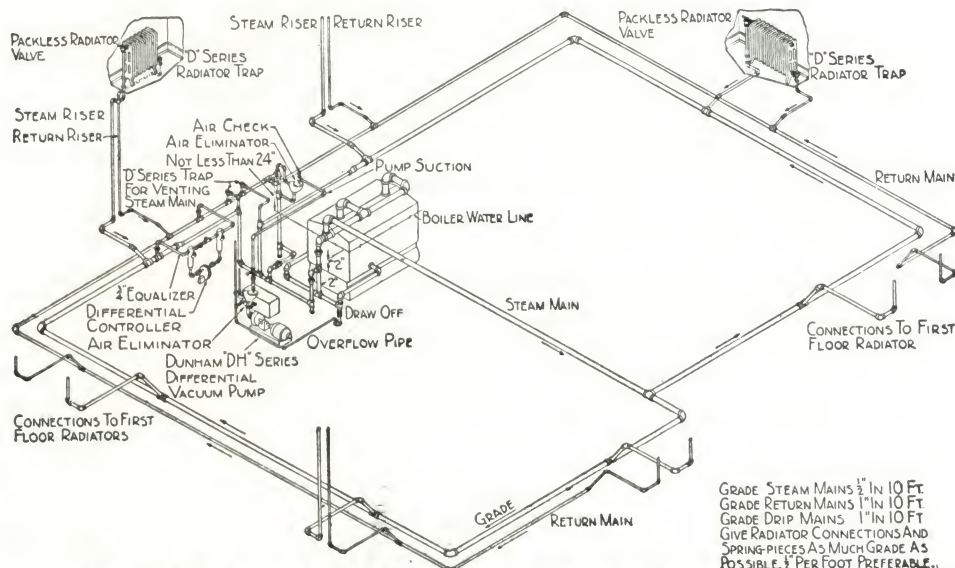


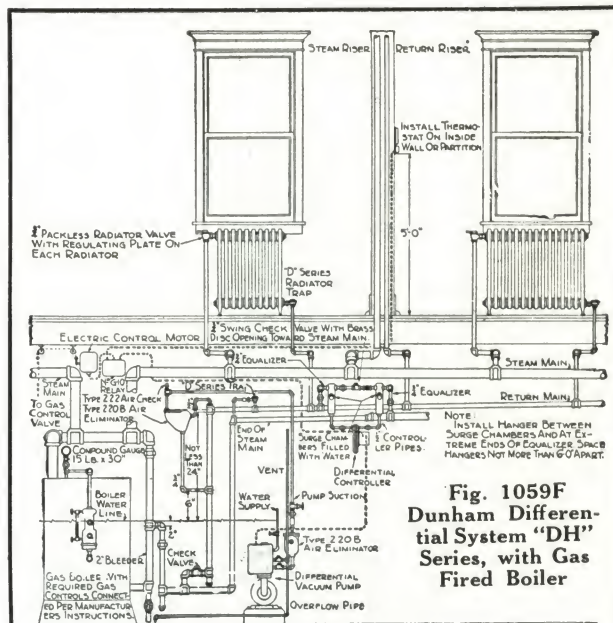
Fig. 1057C. Isometric View of Dunham Differential System “DH” Series

DUNHAM DIFFERENTIAL SYSTEM (Continued)

peratures, but in cold weather the fire will be accelerated for longer periods resulting in lower vacuum and high steam temperatures.

Pump Equipment

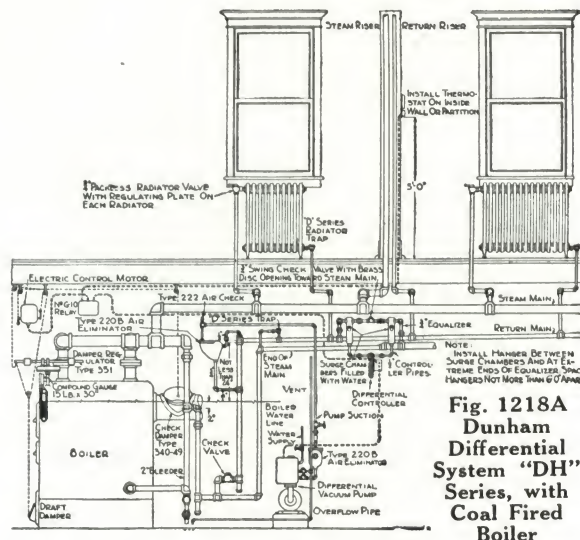
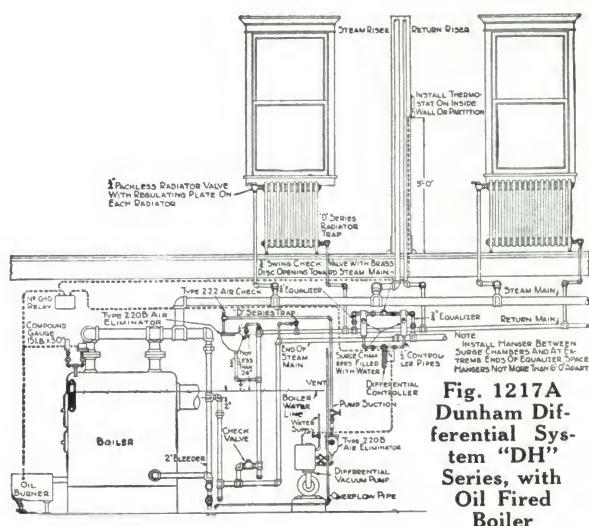
The pump is made in two sizes, DH2A for 2000 sq. ft. capacity and DH3 for 3000 sq. ft. capacity. It uses the Jet Exhauster principle same as the "D" Series Pump. It is to be installed on a low foundation or grouted directly to a suitable basement floor as its location has no relation to the boiler water line. It should be located as remote as possible from principal living rooms. The drawings on this page give application of this



pump on gas, oil or coal fired boilers.

Surge chambers and differential controller, Fig. 1175B, below, are shipped assembled, and should be installed with the equalizer in the piping at the end of the steam main carrying the heaviest load. The controller to be wired to pump motor using armored wire.

In residences single phase current only is ordinarily available. Polyphase current is not available unless the building is connected with a power line. Keep this in mind when specifying the current characteristics for this pump.



DETAILS OF "DH" SERIES PUMP AND DIFFERENTIAL CONTROLLER

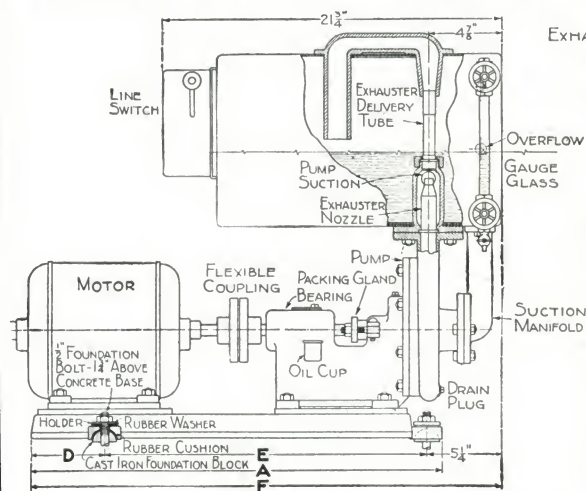


Fig. 1049B. Dimensions "DH" Series Pump. Side and End Elevation

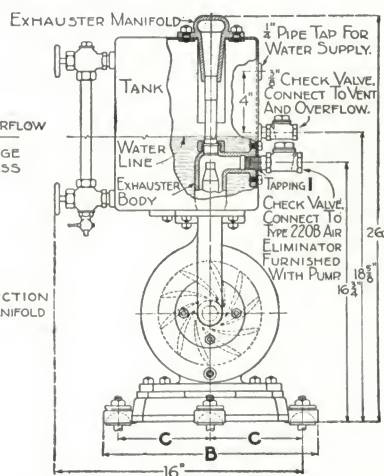


Fig. 1175B. Controller for "DH" Series Dunham Differential

DUNHAM DIFFERENTIAL SYSTEM (Continued)

Heating Specifications "DH" Series, Dunham Differential Vacuum Heating System

(1) **General Conditions**—The general conditions governing this work shall be those established as standard by the American Institute of Architects.

(2) **Construction and Material**—The heating apparatus proposed includes the furnishing, delivery, and erection on the premises of all necessary material and labor, which shall be first class in all particulars and in accordance with specifications and plans.

(3) **Inspection**—The Heating Contractor must at all times allow the C. A. DUNHAM COMPANY'S Representative to come on the job for the purpose of inspection and must lend any assistance necessary to expedite and complete the work. Any instructions given by the C. A. DUNHAM COMPANY'S Representative and confirmed in writing regarding changes to make system conform to plans or specifications and details shall be considered a part of this specification.

(4) **Boiler**—The steam boiler shall be a.....with guaranteed rating for.....sq. ft. of direct radiation installed upon suitable foundation and in accordance with manufacturer's setting instructions. It shall be equipped with all necessary connections and trimmings, including a safety valve set to blow at 10-lb. pressure, a Dunham Compound Gauge 15 lb. x 30-in. vacuum and a 10-in. Dunham Damper Regulator. (Omit Regulator on gas fired and automatic oil fired installations.)

(5) **Smoke Pipe**—Connect boiler to chimney with suitable iron smoke pipe same size as boiler smoke outlet. Smoke pipe must be provided with approved Dunham Check Damper and hand stop damper between check damper and boiler. (Omit Dunham Check Damper on automatic oil fired installations.) (Omit check damper and hand stop damper on gas fired installations.)

(6) **Pipe and Fittings**—Furnish and erect with tight connections all necessary piping of sizes shown on plans and run as indicated, supported and properly graded to insure free and noiseless circulation. Use fittings of cast iron of standard quality. The ends of all pipes shall be reamed or filed. Proper provision must be made for expansion. Use graphite and oil for making up all pipe joints applied to male thread only.

(7) All steam tapplings in boiler shall be connected full size of tapping into a steam header which shall be dripped to the return header through a bleeder. All spring pieces to steam and return mains shall be taken off the top of mains at 45°.

(8) The end of each steam main shall be dripped as indicated on the plans by means of a drip line to boiler, properly vented through Dunham "DI" Trap in accord with details furnished by manufacturer.

(9) Grade steam mains ½ in. in 10 ft. Grade return mains and drip mains 1 in. in 10 ft. All steam supply branches such as spring pieces, offsets in steam risers and runouts to radiators shall in each case be installed one size larger than the vertical pipes to which they connect and shall be given as much grade as possible. ½ in. per ft. is preferable.

(10) Return mains shall be connected to the Dunham Differential Vacuum Pump as shown in detail furnished by manufacturer.

(11) Risers are to be run concealed or in the open as directed by the architect. All concealed piping must be tested and made tight at 15-lb. water pressure before being concealed and covered.

(12) All union connections, flanges, packing nuts on gate and globe valves and on gauge glass of boiler must be drawn up tight so as to prevent air leaking into system when under a high vacuum. This work must be performed after system is completed and while it is working with a vacuum in both steam and return lines.

(13) **Floor Plates, Sleeves**—Furnish approved floor and ceiling plates and protecting sleeves on all pipes passing through floors or finished partitions.

(14) **Thermostatic Control**—Contractor shall furnish and install where shown on plans a Series 10 Minneapolis Honeywell Thermostat according to manufacturer's instruction. (If this thermostat is being supplied with oil or gas burner under another contract, then the Heating Contractor shall connect Differential Vacuum Pump to the Thermostatic Control.)

(15) **Differential Vacuum Pump and Air Eliminator**—Furnish and install a "DH" Series Dunham Differential Vacuum Pump. The pump shall be installed and connected in accordance with manufacturer's instructions and details. The necessary electric wiring between pump and differential control, shall be connected to the thermostatic equipment in accordance with manufacturer's instructions and in conformity with all local regulations.

Furnish and install on return main in accordance with manufacturer's instructions a Dunham Air Eliminator. Install a Dunham Air Check on vent opening of eliminator.

(16) **Check Valves**—Check valves shall be horizontal swing type with brass disc, best grade obtainable. They shall be installed where called for by the plans and in accordance with accompanying details. They shall be tested for tightness.

(17) **Radiation**—Furnish and install radiation as shown on the plans. There shall be.....sq. ft. of direct radiation of approved make. All radiators must be provided with top inlet tapping. Furnish ½-in. eccentric bushing in the return tapping. All air valve tapplings shall be plugged.

(18) **Radiator Traps and Valves**—Each radiator shall be provided with a Dunham "D" Series Radiator Trap of suitable capacity. A Dunham Packless Radiator Valve with Dunham Regulating Plate shall be installed at inlet connection according to manufacturer's instructions.

(19) **Painting**—All exposed piping in finished rooms shall be given a priming coat of flat paint and thereafter painted or enameled as directed by architect. Radiators shall be painted as directed by architect. All pipe joints and all uncovered piping in basement, front and other exposed parts of boiler shall be painted one coat of black asphaltum when the system is hot and under a vacuum. The finishing coat of paint must be applied when the entire system is under vacuum, so that the paint will fill up small leaks.

(20) **Covering**—Cover all steam mains and spring pieces with 4-ply, 1-in. thick asbestos sectional covering and fittings with asbestos cement. Cover all steam and return risers and other piping run concealed in outside walls with two-ply, ½-in. thick asbestos sectional covering. Cover boiler as specified by boiler manufacturer.

(21) **Finishing Up**—After system has been in operation two weeks, thoroughly blow down and clean out system as follows:

Remove the safety valve and connect a temporary blow-off pipe to the safety valve tapping, extending it outside or to some suitable drain. Shut off all radiator valves or valves in main. Fill the boiler with water to top of gauge glass. Build a very hot fire and blow steam and water out through the safety valve tapping and pipe connected thereto. Fire hard with not more than 10-lb. pressure on boiler. Supply cold water constantly in at bottom of the boiler. Continue this for six hours. At the end of the period, close the water feed valve, draw the fire quickly, open blow-off at bottom of boiler and entirely drain the boiler, replace the safety valve. Fill the boiler slowly after it becomes cold.

Remove the cover of each trap and wipe off grease and dirt accumulations. Replace trap cover tightly on body.

(22) **Test**—The system when finished and cleaned shall be tested for tightness by filling it with water to its very top. The water shall be left standing in the system at least four hours after all leaks have been made tight, when final test and inspection in presence of Dunham Representative shall be made for leaks. The contractor must take precaution to guard against damage from freezing during test.

(23) **Guarantee**—The Heating Contractor shall guarantee the apparatus installed to circulate steam thoroughly through every radiator without noise, with a vacuum of 15 in. in steam main. If the apparatus shall fail to accomplish this guarantee by reason of any defect developing within the period of one full heating season and that defect is due to faulty material or poor workmanship, the Heating Contractor shall remedy such defect at his own cost within reasonable time after notice thereof.

(24) **Finally**—Nothing herein contained can be construed to relieve the Heating Contractor from making good and perfect work in all usual details of construction, and he will be held responsible to provide and furnish necessary material and to perform all necessary labor and to bear all expenses incidental to the satisfactory completion of the work.

DUNHAM VACUUM RETURN LINE SYSTEM

The Dunham Vacuum Return Line System is a two-pipe steam heating system, one set of pipes for steam distribution, another set for air and return water. It differs from other forms of steam heating in that circulation is induced more by the vacuum in the return piping, pulling the air out of the radiator and inducing the steam to rush in and fill its place, than by the force or pressure behind the steam pushing it onward to force the air out and displace it.

Comparison with Differential System

The Dunham Differential System is built on the same basic principle and has all the advantages of the Vacuum Return line system plus the superior economy and comfort of positively controlled heat under all operating conditions. This applies to the use of exhaust steam in the Differential System as well as when live steam is used.

Therefore the Dunham Differential Vacuum Heating System described on Dunham Pages 7 to 27 should be specified for any installation where economy of operation is the deciding factor.

Piping and Design

(1) The system using a low pressure heating boiler with a Dunham electric driven vacuum pump suitable for buildings where exhaust steam is not available.

(2) The system using exhaust steam from the engines of

the power plant, supplemented, if needed, by live steam from high pressure boiler. In this case a steam driven pump is used.

Each system is a two-pipe system, using one set of pipes for steam distribution, another for air and return water.

The general position of all the component parts of a system using low pressure on a boiler is clearly shown by the elevation drawing, Fig. 889A. Similar information on a system using exhaust steam is shown by the elevation drawing, Fig. 882A.

All piping, both steam supply and return, must grade in the direction of flow, with the exception of the steam supply spring-pieces to up-feed risers, and the runouts to radiators, which must have especially good grade ($\frac{1}{2}$ in. per foot is recommended) back to the main and riser respectively, and be made of at least one size larger pipe.

The ends of all steam mains, and all other points to be dripped, shall be dripped through proper Dunham Traps installed as shown in details.

Each drip point shall be provided with a scale pocket, a gate valve and strainer on steam side of trap.

No drips from high pressure steam piping shall be connected into the vacuum return piping unless ample Flash Tank is provided and installed. It is best however to run all such drips to the receiver of the boiler feed pump.

The purpose of the drip trap is to drain a certain amount of steam piping. In some cases this is exposed to room temperature of say 70°, in others to temperature in cold space or basement. These conditions determine trap capacity needed.

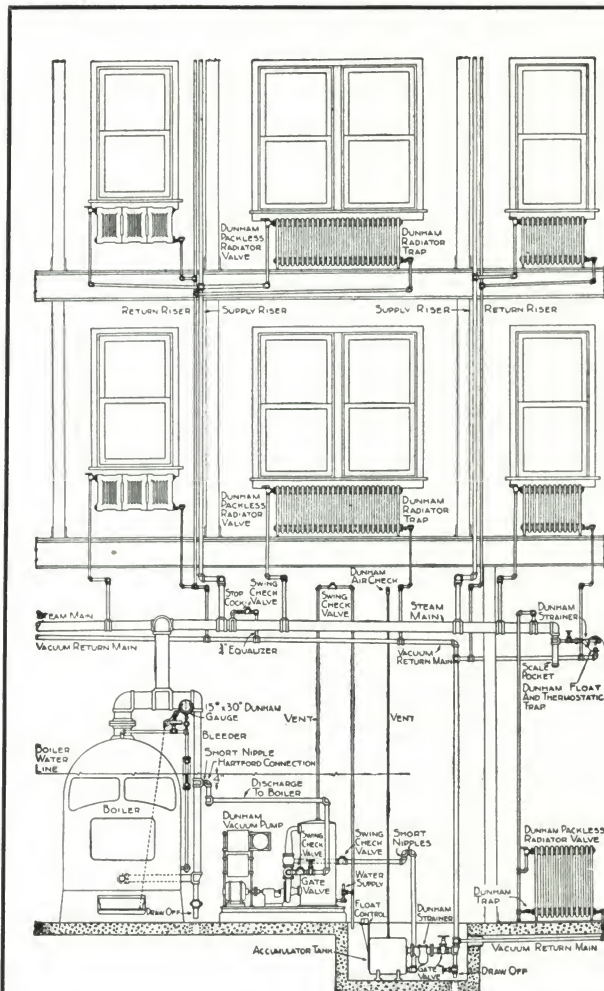


Fig. 889A. Dunham Vacuum Return Line Heating System Using Low Pressure Boiler and Dunham Vacuum Pump with Accumulator Tank and Float Control

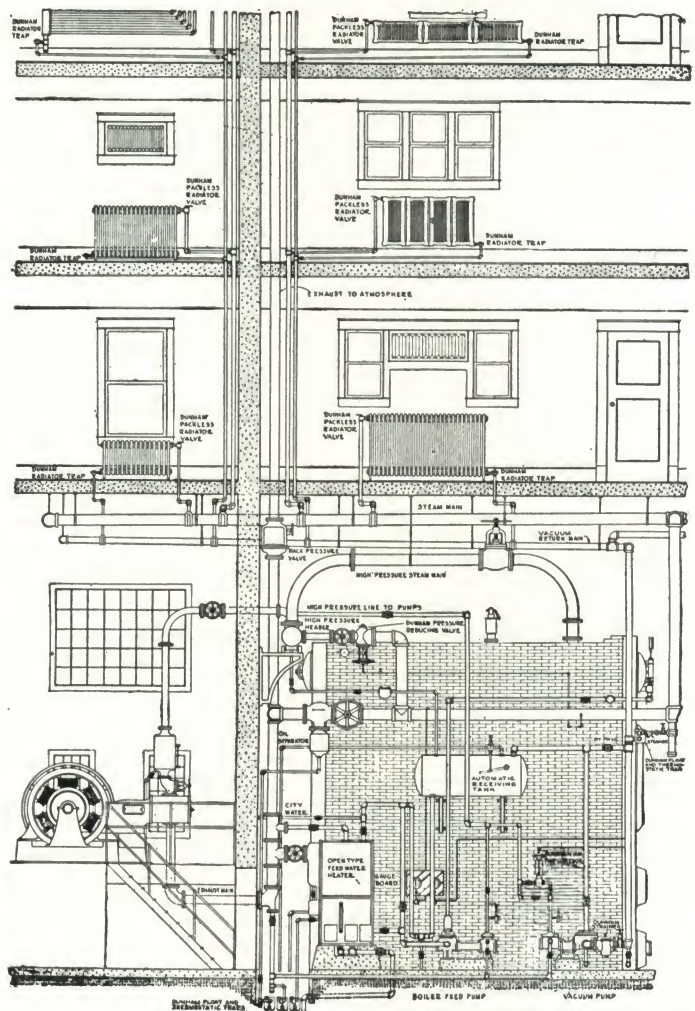


Fig. 882A. Dunham Vacuum Return Line Heating System Using Exhaust Steam

DUNHAM VACUUM RETURN LINE SYSTEM (Continued)

Radiator Connections

Any type of radiation may be used. The supply valve at each radiator for purposes of economy must be of the packless type to prevent the re-admission or leakage of air into the system. Sizes of the connections are given in Table 11, Dunham page 32, also the size of the runout connections.

Removal of Oil

The need for a good oil separator is obvious. It should be automatically dripped through a No. 22 Dunham Float and Thermostatic Trap, installed 6 ft. lower than drip outlet. The drip from the oil separator must go to waste. Fig. 848A shows a Dunham Trap dripping a separator as used on installations operating on pressures above atmospheric.

When the exhaust line is under vacuum the separator cannot be dripped as shown by Fig. 848A. It must be dripped through a No. 9A

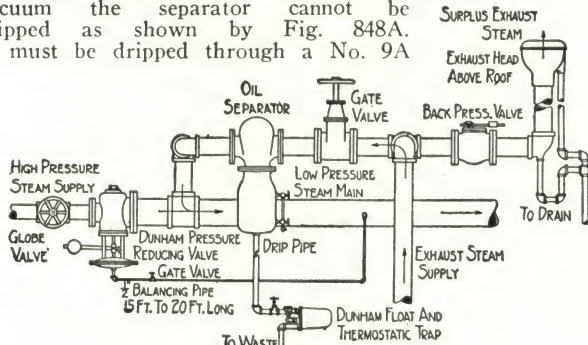


Fig. 899B

Dunham Trap as shown by Fig. 968A, installing pipe "B" which should be terminated near the ceiling. Omit connections "A." These are used when it is necessary to lift the waste from the oil separator to discharge it to sewer located at a higher level. The return trap with a 1-in. Dunham Pressure Reducing Valve and all connections at "A," are included. Omit pipe "B" when connection "A" is used.

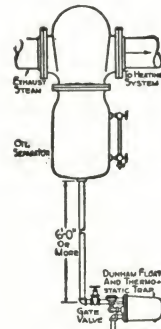


Fig. 848A

Method of draining oil separator on system using exhaust steam above atmospheric pressure

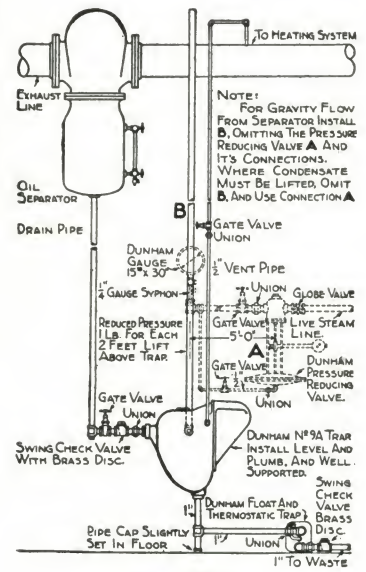


Fig. 968A

Method of draining oil separator on exhaust heating system carrying vacuum on exhaust line (connection B) as used in the Dunham Differential System. To lift waste to sewer located at higher level, use connection A

Pipe Sizes

The desired initial pressure and the allowable drop in pressure control the sizing of the piping. The following capacity tables are based upon a 1 lb. pressure drop in the total given length of straight smooth pipe. To maintain a pressure in the farthest radiator an initial pressure of 2 lb. should be maintained. When a lesser initial pressure is desired with a corresponding smaller drop the piping should be more liberal in size.

In using these tables the length of run is the distance along the piping from the source of steam supply to the farthest radiator, with all allowances for resistance of

elbows and valves expressed in terms of equivalent lengths added. For these allowances see Table 6, Dunham page 34.

Spring pieces, that is, the connections from the horizontal mains to the vertical risers, must always be made one size larger than the riser.

The steam and return mains must be carefully and uniformly graded in the direction of flow with a fall of not less than $\frac{1}{2}$ in. in 10 ft. Spring pieces and radiator runouts must be given maximum possible grade toward the main and riser respectively, not less than $\frac{1}{2}$ in. per foot.

TABLE 12. STEAM MAINS. VACUUM RETURN LINE SYSTEM

Pipe sizes, in.	Capacities in square feet of direct cast iron radiation for each length of run										
	*Length of runs in feet (see note in last column, this table)										
	100	200	300	400	500	600	800	1,000	1,500	2,000	3,000
2	1,130	800	650	570	500	450	400	350	300	250	200
2½	2,100	1,470	1,200	1,050	925	840	735	650	550	460	380
3	3,800	2,660	2,160	1,900	1,670	1,520	1,330	1,180	990	830	680
3½	5,500	3,850	3,140	2,750	2,420	2,200	1,920	1,700	1,430	1,210	990
4	7,750	5,400	4,400	3,900	3,400	3,100	2,700	2,400	2,000	1,700	1,400
5	13,800	9,650	7,800	6,900	6,100	5,500	4,800	4,300	3,600	3,040	2,480
6	22,200	15,500	12,600	11,000	9,800	8,900	7,800	6,900	5,700	4,900	4,000
8	46,000	32,000	26,200	23,000	20,200	18,400	16,100	14,200	12,000	10,100	8,300
10	80,700	56,500	46,000	40,300	35,500	32,200	28,200	25,000	21,000	17,700	14,500
12	127,000	89,000	72,500	63,500	56,000	51,000	44,500	39,400	33,000	28,000	23,000
14 OD	164,000	115,000	93,500	82,000	72,000	65,600	57,400	51,000	42,600	36,100	29,500
16 OD	234,000	164,000	133,400	117,000	103,000	93,600	82,000	72,600	61,000	51,500	42,100

TABLE 13. RETURN MAINS. VACUUM RETURN LINE SYSTEM

Pipe sizes, in.	1	1¼	1½	2	2½	3	3½	4	5	6
Capacity in square feet	400 ft.	800	1,600	4,000	11,000	21,000	38,000	55,000	78,000	138,000
1,000 ft.	500	1,000	2,500	7,000	13,000	23,500	34,000	48,000	66,000	138,000
2,000 ft.	350	800	1,800	5,000	9,000	16,000	24,000	34,000	60,000	98,000
3,000 ft.	300	600	1,500	4,000	7,500	13,500	20,000	28,000	50,000	80,000

TABLE 14. VERTICAL RISER SIZES

Pipe sizes		Steam risers									Return risers		
		¾	1	1¼	1½	2	2½	3	3½	4	¾	1	1¼
*Capacity in square feet	200 ft.	66	133	290	450	920	1,510	2,660	3,850	5,400	1,000	2,000	4,500
	400 ft.	47	95	210	325	655	1,080	1,900	2,750	3,900	800	1,600	3,400
per length of	600 ft.	38	76	166	260	525	865	1,520	2,200	3,100	640	1,200	2,500
run in feet.	1,000 ft.	29	59	129	200	410	670	1,180	1,700	2,400	500	1,000	2,100
(See note in last column, this table)	2,000 ft.	20	42	92	143	290	475	830	1,210	1,700	350	700	1,500

(See note in last column, this table)

NOTES*

*For Table 12—The length equals the distance along piping from source of steam supply (Boiler, Pressure Reducing Valve or Central Station, Service Main) to farthest radiator plus allowance for elbows and valves in main (Table 6, Dunham Page 34) and plus 25 ft. allowance for last or top radiator connection.

*For Table 14—The length of run equals the distance along piping from source of steam supply to the top of each riser plus the allowance for elbows, valves (Table 6, Dunham Page 34) and plus a 25-ft. allowance for resistance to entrance to radiator.

For Radiator Connections, see Table 11, Dunham Page 32, and Dunham Pages 37, 38, this catalogue.

DUNHAM VACUUM RETURN LINE SYSTEM (Continued)

Sags and Pockets

Emphasis is placed upon the need for careful piping, design and installation; the entire avoidance of sags or pockets; and the careful grading of all spring pieces and run-outs.

A vacuum system should be designed and installed so that the entire piping will completely free itself from all water by gravity.



Fig. 900

Water pockets result from improperly graded or bent piping

Lift Connections

While it is possible to locate radiators and piping below return piping by using lift connections, it is not always advisable to do what is possible. The suggestion is made that lift fittings be used sparingly, and only when absolutely necessary. A vacuum system without lifts can circulate under emergency conditions without the vacuum pump. Where lifts are present the vacuum pump must be continually in operation, or circulation is stopped. Lifts must always be provided with a lift pocket and draw off at low point. Lift at radiators must have the Dunham Trap at high point, or above the lift as illustrated in Fig. 958A, Dunham page 47. The lift connection should always be carried above the pipe into which it is discharged. (Fig. 957A, page 47). Dunham Lift-Fittings are made in sizes $\frac{3}{4}$ to 2 in. inclusive. See also Fig. 879 on Dunham page 47 for lift connection in return main.

Vacuum Pump

Data on the Dunham Vacuum Pump will be found on Dunham pages 52, 53, 54 and 55. It is always preferable to install the pump so that the return will always be above the suction inlet of pump. Should unavoidable necessity bring the return below the pump suction a lift pocket must be provided, and the connection made as illustrated in Fig. 879, Dunham page 47 and Fig. 880A. The Dunham Accumulator Tank gives good service in such cases, omitting lift pocket and placing tank in the pit. The air and condensate drain into the tank

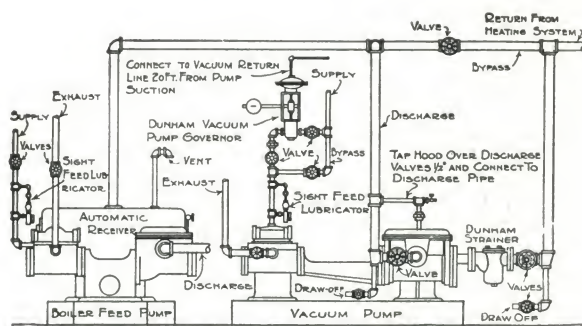


Fig. 883A. Showing Connections to Steam Operated Vacuum Pump, Boiler Feed Pump with Automatic Receiver

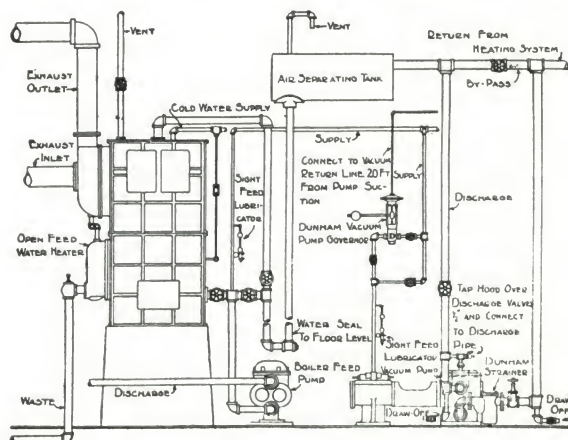


Fig. 885A. Connections to Steam Operated Vacuum Pump, Automatic Boiler Feed Pump and Open Feed Water Heater

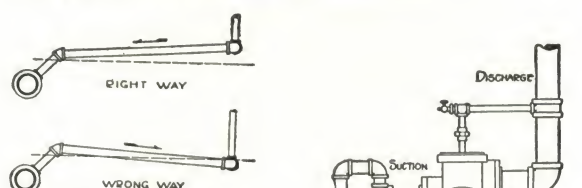


Fig. 872. Showing Correct and Incorrect Grades of Spring Pieces

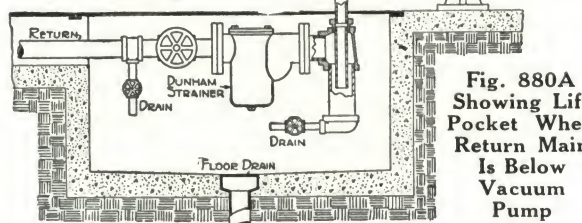


Fig. 880A. Showing Lift Pocket When Return Main Is Below Vacuum Pump

and when high water level is reached the float operated electric switch will start the Dunham Vacuum Pump, thus securing drainage of system regardless of vacuum being present on system—an important advantage for night service as the vacuum pump then can function as a condensation pump.

The discharge from the Dunham Vacuum Pump is brought back direct to boiler through a swing check valve and gate valve. Fig. 898A.

The discharge from a steam operated vacuum pump may go directly to a liberally vented receiver of an automatic boiler feed pump, Fig. 883A, or to an air separating tank. From the tank the returns may flow by gravity through a feed water heater, to the boiler feed pump to be returned to the boiler. Fig. 885A. The operation of the vacuum pump should be automatically controlled by the Dunham Vacuum Pump Governor. The cylinder of the vacuum pump should be protected from damage by foreign matter by the Dunham Suction Strainer. It is good design to provide a valved by-pass around vacuum pump so that returns may go directly to boiler in the case of the electric driven pump, or in case of the steam pump to boiler feed pump to care for emergency conditions. (Fig. 883A).

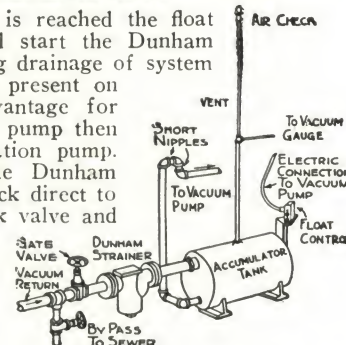


Fig. 714A. Connections to Dunham Accumulator Tank

Equalizer Connection

The steam and return mains should be connected at a convenient point in boiler room as shown by Fig. 1153. This method will equalize the system when a natural partial vacuum is formed on low fire operation.

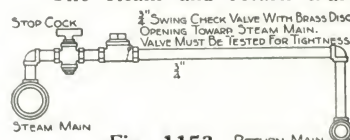


Fig. 1153

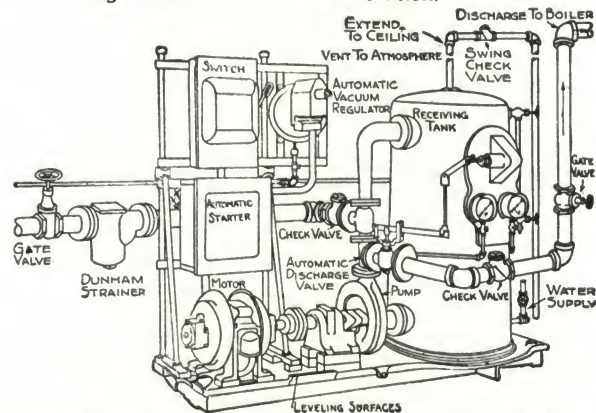


Fig. 898A. Dunham Centrifugal Vacuum and Boiler Feed Pump with Automatic Vacuum Control

See pages 52-55 for additional installation instructions

DUNHAM VACUUM RETURN LINE SYSTEM (Continued)

Automatic Exhaust Steam Control

The Dunham Vacuum Heating System in using exhaust steam, provides a simple arrangement to supply live steam automatically, if for any reason the exhaust steam becomes insufficient for the heating requirements. This is accomplished by the arrangement of a back-pressure valve and a Dunham Pressure Reducing Valve installed in the horizontal steam main. The pressure balancing pipe from low pressure steam main to bottom of the diaphragm of the reducing valve is connected at a distance of not less than 20 ft. from the reducing valve. A gate valve being installed as shown in Fig. 899B

Dunham Page 28. The back pressure valve prevents waste of steam through the exhaust head as long as the heating system requires steam. With an over-supply of exhaust steam, the pressure increases. When it reaches the maximum point for which the back pressure valve is set, this valve, acting as a safety valve, opens and releases the steam through the exhaust head. When the heating system requires more steam than is supplied by the exhaust, the pressure decreases. Then the reducing valve opens at the pressure for which it is set, supplies live steam as long as it is needed and then automatically closes.

Specifications for Dunham Vacuum Return Line Heating System

(1) **General Conditions**—The general conditions governing this work shall be those established as standard by the American Institute of Architects which shall apply hereto.

(2) **Construction and Material**—The heating apparatus, proposed herewith includes the furnishing, delivery and erection on the premises of all necessary material and labor, which shall be first class in all particulars, and in accordance with the specifications and plans.

(3) **Inspection**—The Heating Contractor must at all times allow the C. A. DUNHAM COMPANY'S Representative to come on the job for the purpose of inspection and must lend any assistance necessary to expedite and complete the work. Any instructions given by the C. A. DUNHAM COMPANY'S Representative and confirmed in writing regarding changes to make system conform to plans or specifications and details shall be considered a part of this specification.

(4) **Boiler**—The steam boiler shall be a.....with guaranteed rating for..... sq. ft. of radiation installed upon suitable foundation, and equipped with all necessary connections and trimmings, including a safety valve set to blow at 10 lb. pressure, a Dunham Compound Gauge 15 lb. x 30-in. vacuum and a 7-in. Dunham Damper Regulator. (Omit Regulator on gas fired and automatic oil fired installations.)

(5) **Smoke Pipe**—Connect boiler to chimney with suitable black iron smoke pipe gauge..... Size to be as recommended by Boiler Manufacturer. Smoke pipe must be provided with hand stop damper. (Omit Hand Stop Damper on gas fired installations.)

(6) **Pipe and Fittings**—Furnish and erect with tight connections all necessary piping of sizes shown on plans and run as indicated, supported and properly graded to insure free and noiseless circulation. Use fittings of cast iron of standard quality. The ends of all pipes shall be reamed or filed. Proper provision must be made for expansion. Use graphite and oil for making up all pipe joints applied to male thread only. Provide for expansion of mains and risers by loop type expansion joints and swing connections in mains wherever possible. In other cases provide approved all-metal packless expansion joints. Piping to be properly anchored.

(7) All steam tappings in boiler shall be connected full size of tapping into a steam header which shall be dripped to the return header through a bleeder. All spring pieces to steam and return mains shall be taken off the top of mains at 45 degrees. On downfeed systems take the spring pieces from the bottom of steam main at 90°.

(8) The end of each steam main and each drip point shall be drained, through a gate valve, Dunham Strainer, and Dunham Trap as indicated on plans.

Drip the bottom of each down-feed riser through Dunham Trap into dry return main. No lift connections shall be used at drip points.

(9) Grade steam mains, return mains and drip mains ½ in. in 10 ft. All steam supply branches such as spring pieces, offsets in steam risers and runouts to radiators shall in each case be installed one size larger than the vertical pipes to which they connect and shall be given as much grade as possible. ½ in. per ft. is preferable.

(10) Return mains shall be connected together into the Dunham Vacuum Pump as shown in detail furnished by manufacturer. Lift connections must not be used except at the pump.

(11) Risers are to be run concealed or in the open as directed by the architect. Install traps as instructed by manufacturer. All concealed piping must be tested and made tight at 15 lb. water pressure before being concealed and covered.

(12) All union connections, flanges, packing nuts on gate and globe valves and on gauge glass of boiler must be drawn up tight so as to prevent air leaking into system when under a partial vacuum. This work must be performed after system is completed and while it is under a vacuum in both steam and return lines.

(13) **Floor Plates, Sleeves**—Furnish approved floor and ceiling plates, protecting sleeves on all pipes passing through floors or finished partitions.

(14) **Dunham Vacuum Pump**—Furnish and install one (or Duplex) Dunham Vacuum Pump of size....., having a rating of sq. ft. of equivalent direct radiation. The pump (or pumps) shall be installed, connected and wired in accordance with manufacturer's instruction.

(15) **Check Valves**—Check valves shall be horizontal swing type with brass disc, best grade obtainable. They shall be installed where called for by the plans, and in accordance with accompanying details. They shall be tested for tightness.

(16) **Radiation**—Furnish and install radiation as shown on the plans. There shall be..... sq. ft. of direct radiation of approved make. All radiators must be provided with top inlet tapping and with ½-in. eccentric bushing in the return tapping. All air valve tappings shall be plugged.

(17) **Radiator Traps and Valves**—Each radiator shall be provided with a Dunham Radiator Trap of suitable capacity. A Dunham Packless Radiator Valve shall be installed at inlet connection.

(18) **Painting**—All exposed piping in finished rooms shall be given a priming coat of flat paint and thereafter painted or enameled as directed by architect. Radiators shall be painted as directed by architect. All pipe joints and all uncovered piping in basement, front and other exposed parts of boiler shall be painted one coat of black asphaltum when the system is hot and under a vacuum. The finishing coat of paint must be applied when the entire system is under vacuum, so that paint will fill up small leaks.

(19) **Covering**—Cover all steam mains and spring pieces with four-ply, 1 in. thick asbestos sectional covering, and fittings with asbestos cement. Cover all steam and return risers and other piping run concealed in outside walls with two-ply, ½ in. thick asbestos sectional covering. Cover boiler as specified by boiler manufacturer.

(20) **Finishing Up**—After system has been in operation two weeks, thoroughly blow down and clean out system as follows:

Remove the safety valve and connect a temporary blow-off pipe to the safety valve tapping, extending it outside or to some suitable drain. Shut off all radiator valves or valves in main. Fill the boiler with water to top of gauge glass. Build a very hot fire and blow steam and water out through the safety valve tapping and pipe connected thereto. Fire hard with not more than 10 lb. pressure on the boiler. Supply cold water constantly in at bottom of the boiler. Continue this for six hours. At the end of the period, close the water feed valve, draw the fire quickly, open blowoff at bottom of boiler and entirely drain the boiler; replace the safety valve. Fill the boiler slowly after it becomes cold.

Remove the cover of each trap and wipe off grease and dirt accumulation. Replace trap cover tightly on body. Install the Dunham Regulating Plates in the radiator valves.

(21) **Guarantee**—The Heating Contractor shall guarantee the apparatus installed under these specifications to circulate steam thoroughly through every radiator without noise, under a steam pressure on the heating mains not to exceed two pounds. If the apparatus shall fail to accomplish this guarantee by reason of any defect developing within the period of one full heating season and that defect is due to faulty material or poor workmanship, the Heating Contractor shall remedy such defect at his own cost within reasonable time after notice thereof.

(22) **Finally**—Nothing herein contained can be construed to relieve the Heating Contractor from making good and perfect work in all usual details of construction, and he will be held responsible to provide and furnish necessary material and to perform all necessary labor and to bear all expenses incidental to the satisfactory completion of the work.

THE DUNHAM RETURN HEATING SYSTEM

The Dunham Return Heating System is a system utilizing steam at any desired pressure up to 15 lb. An operating pressure of 1 lb. is recommended as the most economical. The use of the Dunham Return Trap and Dunham Air Eliminator provides an automatic return of water to the boiler when it is desired to raise the steam pressure.

The Dunham Return Heating System is a two-pipe system. The steam and the water of condensation each have their respective pipes, and, by virtue of the Dunham Radiator Trap, steam cannot enter the return pipe until it condenses and becomes water. Collision between steam and water is thus made impossible and unpleasant noises eliminated. The sputtering, leaking air valve on each radiator is also eliminated. The air, which freely passes through the trap, is conducted away in the pipe which carried away the water.

The Dunham System makes possible maximum radiator efficiency, and the use of every bit of steam in the radiators; none is wasted. It keeps the radiators free from air, permitting a quick and rapid circulation. The radiators are each easily controlled by a non-leakable radiator valve.

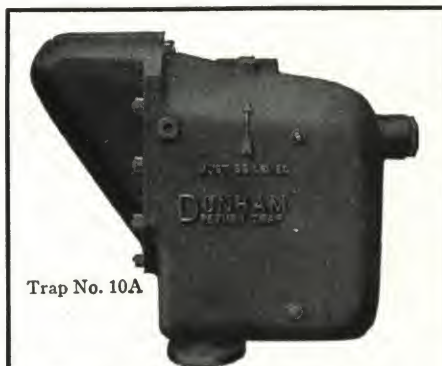
Principal Parts

In its physical parts the Dunham Return Heating System consists principally of a steam boiler, radiators, piping, the Dunham Radiator Trap, the Dunham Packless Radiator Valves with regulating plates, and the Dunham Return Trap or Condensation Return Pump. Any good reputable make of boiler of proper capacity for the radiation may be used. Radiators may be of any good recognized make. The Dunham Company does not sell boilers, radiators, or pipe; it sells only the Dunham heating appliances. The Company also furnishes information covering the preferable methods of installing the entire plant to make possible a successful heating system.

Specifications

Articles 1 to 3 inclusive same as for Dunham Vacuum Return Line System, see Dunham Page 30 this catalogue.

4. **Boiler**—The steam boiler shall be a with guaranteed rating for sq. ft. of direct radiation installed upon suitable foundation and in accordance with manufacturer's setting instructions. It shall be equipped with all necessary connections and trimmings, including a safety valve set to blow at 10-lb. pressure, a Dunham Compound Gauge 15 lb. x 30-in. vacuum and a



Trap No. 10A

The Heart of the Dunham Return Heating System

The Dunham Return Trap

See Dunham Page 47 in this Catalogue for full description

7-in. Dunham Damper Regulator. (Omit Regulator on gas fired and automatic oil fired installations.) The boiler must be so installed that the distance between the normal boiler water line and the lowest return pipe shall permit the installation of the return trap at the height hereinafter specified. Furnish boiler pit if necessary.

5. **Smoke Pipe**—Connect boiler to chimney with suitable iron smoke pipe same size as boiler smoke outlet. Smoke pipe must be provided with approved Dunham Check Damper and hand stop damper between check damper and boiler. (On gas and automatic oil fired installations omit Dunham Check Damper.) (Omit hand stop damper on gas fired installations.)

Articles 6 and 7 same as Dunham Page 30.

8. The end of each steam main shall be dripped in the manner indicated on the plans. If dripped directly to the boiler, each drip must be sealed below water line before being connected with any other drip, and a Dunham Trap must be installed at the top. When dripped through Dunham Traps into the dry return piping, a full size scale pocket must be provided and the Dunham Trap shall be installed at least four feet from the scale pocket, and located above the dry return piping, into which they discharge. A gate valve and Dunham Strainer shall be installed on the inlet side of each Dunham Trap used for dripping purposes.

9. Grade steam mains $\frac{1}{2}$ in. in 10 ft. Grade return mains and drip mains 1 in. in 10 ft. All steam supply branches such as spring pieces, offsets in steam risers and run-outs to radiators shall in each case be installed one size larger than the vertical pipes to which they connect and shall be given as much grade as possible, $\frac{1}{2}$ in. per foot is preferable.

10. Return mains shall be connected to the Dunham Return Trap as shown in detail furnished by manufacturer.

Articles 11, 12 and 13 same as Dunham Page 30.

14. **Return Trap**—Install as shown, a No. Dunham Return Trap, setting same level and plumb, and with its bottom not less than 6 in. above the boiler water line. Make piping connections in accordance with the details furnished with trap, place return trap as much higher as return piping permits. A steam connection full size of tapping in trap shall be made directly with the steam header at boiler.

Furnish and install in accordance with manufacturer's instructions a Dunham Air Eliminator. Install a Dunham Air Check, Type 222, on vent opening of Eliminator.

Articles 15 to 22 inclusive same as Dunham Page 30.

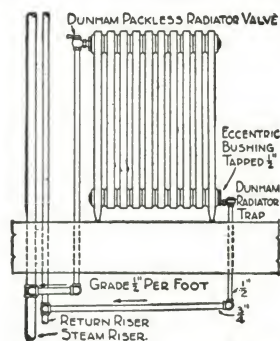


Fig. 807B. Runouts Below Ceiling

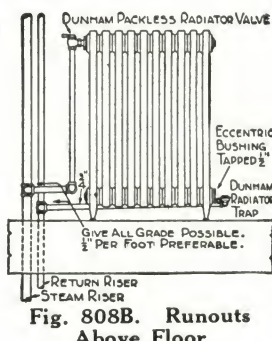


Fig. 808B. Runouts Above Floor

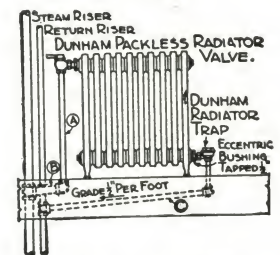


Fig. 809B. Runouts Between Floor and Ceiling

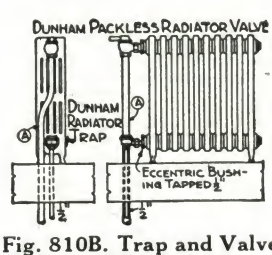


Fig. 810B. Trap and Valve at Same End of Radiator

Column radiators only, not to exceed 15 sections. Recommended for upper floors in small buildings to simplify piping.

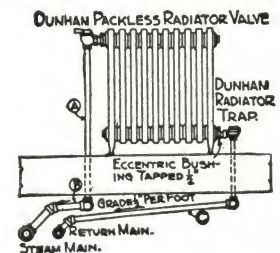


Fig. 813A. Spring Pieces and Radiator Connections for First Floor Radiator

General Note: Grade all horizontal spring pieces and runouts not less than $\frac{1}{2}$ in. per foot.

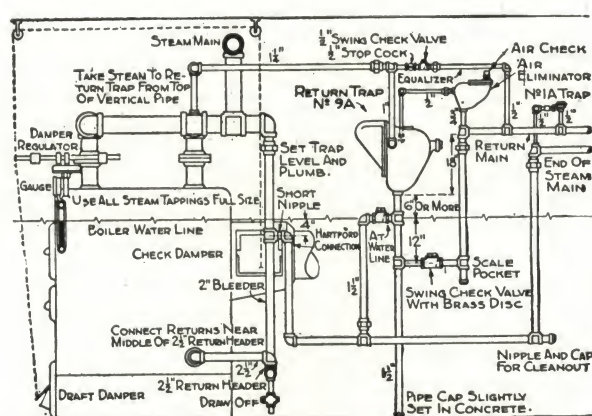


Fig. 962A. Boiler Connections for Dunham Return Trap 9A

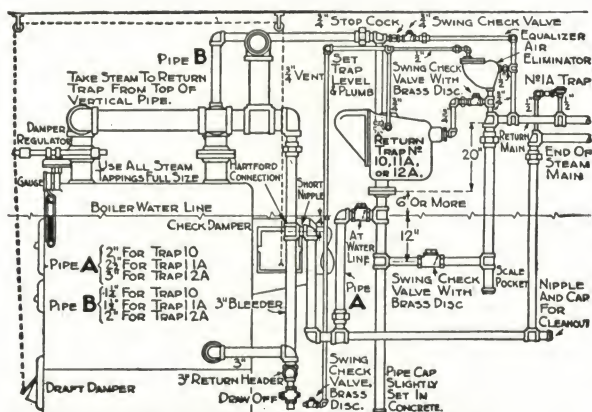


Fig. 963A. Boiler Connections for Traps 10A, 11A, 12A

THE DUNHAM RETURN HEATING SYSTEM (Continued)

TABLE 7. STEAM MAINS. RETURN HEATING SYSTEM

Pipe sizes inches	Capacities in square feet of direct cast iron radiation for each length							
	*Length in feet							
	100	200	300	400	500	600	800	1000
2	670	570	470	410	360	330	290	250
2½	1,090	930	760	670	590	520	470	410
3	1,930	1,650	1,340	1,170	1,030	940	820	730
3½	2,810	2,400	1,950	1,710	1,510	1,370	1,200	1,060
4	3,900	3,340	2,720	2,380	2,100	1,900	1,670	1,480
5	7,000	5,950	4,850	4,260	3,740	3,400	2,980	2,640
6	11,200	9,550	7,780	6,830	6,000	5,460	4,780	4,240
8	23,400	20,000	16,250	14,250	12,540	11,400	10,000	8,840
10	40,800	34,800	28,400	24,800	21,900	19,900	17,400	15,400

*Length equals distance along piping from source of steam supply to top of each riser plus allowances for elbows, valves (Table No. 6, Dunham Page 34) and plus 25 ft. allowance for radiator connection.

TABLE 8. RETURN MAINS. RETURN HEATING SYSTEM

Pipe sizes	Capacity in square feet								
	1	1¼	1½	2	2½	3	3½	4	5
Mains under 400 ft. long.....	400	1,400	2,700	5,500	9,000	16,000	23,000	32,000	57,000
Mains over 400 ft. long.....	300	1,000	1,700	3,400	5,500	10,000	14,000	20,000	35,000

TABLE 9. STEAM MAIN DRIPS. RETURN HEATING SYSTEM

Pipe Sizes.....	1¼	1½	2	2½	3	3½	4	5
Capacity in sq. ft.....	1,400	2,700	5,500	9,000	16,000	23,000	32,000	57,000

TABLE 10. RISER SIZES. RETURN HEATING SYSTEM

Pipe sizes	Steam							Return	
	¾	1	1¼	1½	2	2½	3	¾	1
*Length, 200 ft.	45	90	190	290	570	930	1,650	600	1,200
*Length, 400 ft.	30	60	136	200	410	670	1,170	430	850
*Length, 600 ft.	25	50	110	165	330	530	940	340	670
*Length, 1,000 ft.	20	40	85	130	250	410	730	260	530

Springpieces, that is, connections from steam main to risers, must always be made one size larger than the riser. Return springpieces same size as return riser.

TABLE 11. RADIATOR CONNECTIONS. RETURN AND VACUUM RETURN LINE HEATING SYSTEMS

Use Table 5 when Valve Type 105 or 145 with Regulating Plate is used

Square feet direct radiation	Supply			Return		
	Inlet valve in.	Vertical pipe to inlet valve in.	Horizontal runout to riser or spring piece to main from a first floor radiator, in.	Trap No.	Stub to trap and size of trap	Horizontal runout to riser or first floor radiator
1-25	½	½	¾	1A	½	¾
26-80	¾	¾	1	1A	½	¾
81-100	¾	¾	1¼	1A	½	¾
101-140	1	1	1¼	2B	½	¾
141-180	1	1	1½	2B	½	¾
181-300	1¼	1¼	2	2B	½	¾
*301-450	1½	1½	2	3A	*¾	¾
451-700	2	2	2½	3A	¾	¾

*No. 2B trap up to 350 sq. ft. ½ in. stub and size. Use pipes one size larger for horizontal connections over 8 ft. 0 in. long. Grade with a fall not less than ½ in. per foot.

Piping and Method of Dripping Steam Mains

The piping is of vital importance. It should be designed to meet the needs of each particular job, and sized accordingly. It must be carefully installed, properly and well graded, and entirely free from sags or pockets. Provision must be made for expansion so that it will not destroy the proper grade of the piping. The ends of the steam mains in a Dunham Return Heating System may be dripped and freed from air in two distinct ways. The first way is described and illustrated in Fig. 844A.

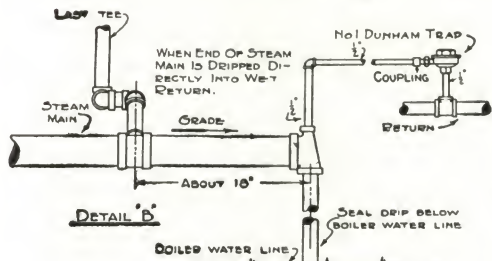
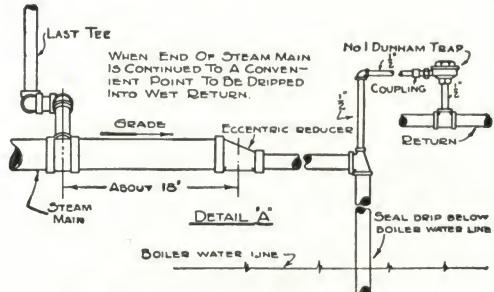


Fig. 844A

This method is not to be followed when a reducing valve is used and the pressure in the steam mains is less than that in the boiler. This method is recommended whenever applicable because it admits of the return piping being installed higher up than would otherwise be the case. The air is vented into the return main, and the water is returned direct to the boiler through the drip piping. No two drips should be connected above the water line.

The second method consists in the installation of a Dunham Float and Thermostatic Trap of proper capacity at the drip points of the steam main to drip directly into the return main from radiation as shown in Figs. 924B and 925B. The condensate as well as the air in this case passes into the return main, and the water is returned to the boiler by the return trap or condensation pump. This method must always be used when a reducing valve is used, and whenever building construction prevents using method shown in Fig. 844A.

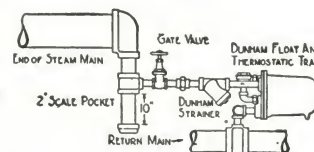
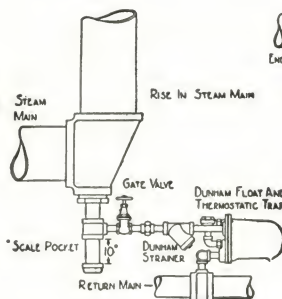


Fig. 925B. Method of Dripping End of Steam Main

Fig. 924B. Method of Dripping Rise in Steam Main

Equalizer Connections

The steam and return mains on the Return Trap System are cross connected as shown in illustrations. This connection equalizes the system when a natural partial vacuum is formed on a declining fire. At such times there is a tendency for a higher vacuum to be formed on the steam side of the system than on the return side. The equalizer prevents this disadvantage to circulation.

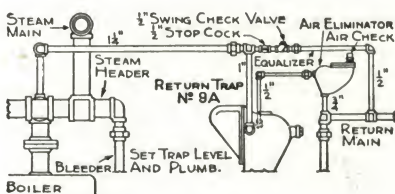


Fig. 1204

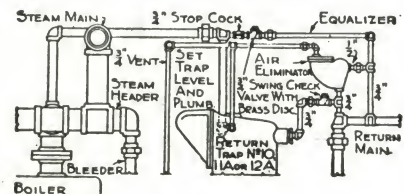


Fig. 1204

THE DUNHAM HOME HEATING SYSTEM

This is a vapor system (using steam at very low pressure, like that in a teakettle) giving an even, easily controlled and economical distribution of heat throughout the entire home.

It is simple and unfailing in operation. The small amount of steam is quickly developed and uniformly distributed through all the radiators. The radiators operate silently. The clanging and hissing commonly heard with old type steam heating systems is absent. The sputtering, smelly air valves and leaky control valves are replaced by Dunham Packless Radiator Valves and the famous Dunham Radiator Traps. Every Radiator may be kept hot from end to end. No steam is wasted.

How a Dunham Heating System Operates

The economical use of low pressure steam is possible because *two* pipes are used; one to carry steam to the radiator and one to carry air and condensate (steam turned to water in cooling) from the radiator. The use of two pipes was impractical prior to the invention of the Dunham Radiator Trap and Valve, illustrations and description of which are to be found further on in this catalogue.

With the Dunham System there is no opportunity for a collision between steam and water. Each has its

respective pipes, and steam cannot enter the outlet pipe until it condenses and becomes water. The Dunham System makes absolutely unnecessary any air valves on the radiators. It uses every bit of steam within the radiators, allowing none to pass out and go to waste. It keeps the radiators free from air and water and permits quick and rapid circulation of steam. The radiators are easily controlled by non-leakable, quick opening radiator valves placed in a convenient position where they can be reached without stooping.

What Makes Up a Dunham Home Heating System

In its physical parts the system consists principally of a steam boiler, radiators, piping to and from the radiators, the Dunham Packless Radiator Valves with Regulating Plates, and the Dunham Radiator Traps. Any good reputable make of boiler of proper capacity for the radiation may be used. The radiators may be of any good recognized make. The Dunham Company does not sell boilers, radiators, or pipe; it supplies only the Dunham appliances. The Company also furnishes information covering the preferable methods of installing the entire plant to make possible a successful heating system.

For complete description of Dunham appliances used on this system, see pages following.

Installation

The Dunham Home Heating System may be installed by any competent and experienced steam heating contractor. The Dunham products are sold only through the responsible steam heating trade.

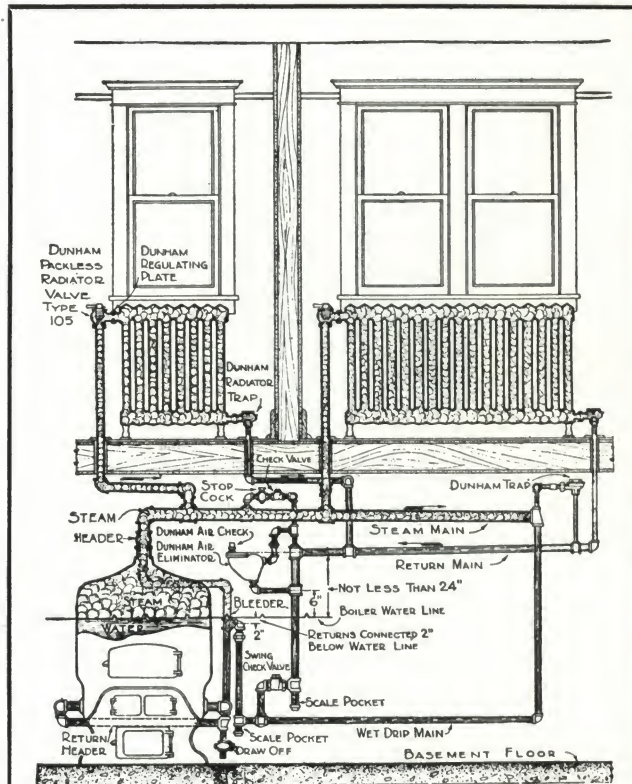


Fig. 907D. The Dunham Home Heating System

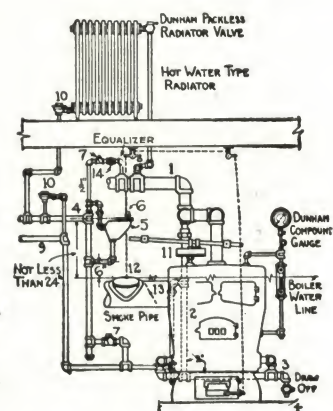
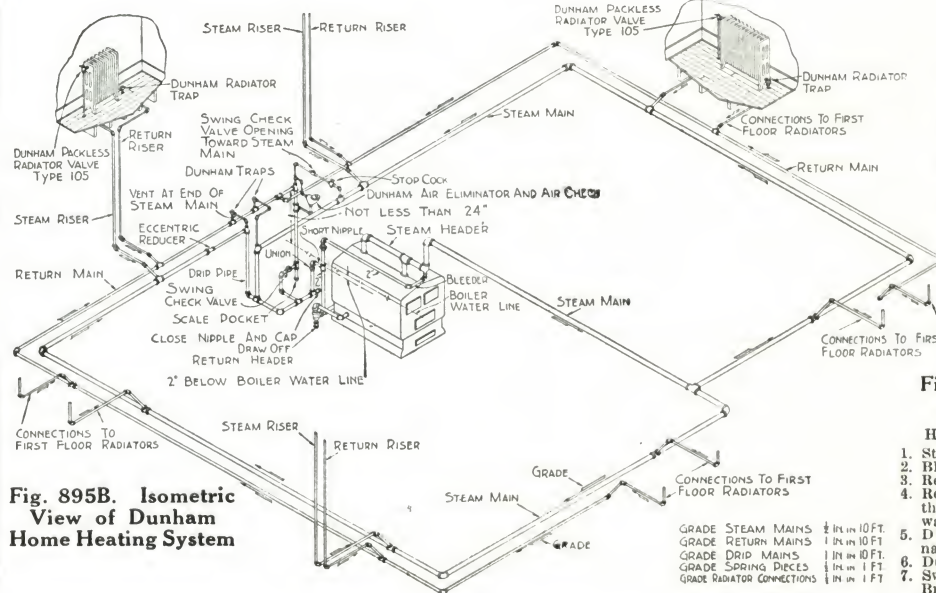


Fig. 960C. Typical Connections to Boiler

HAVING TWO OR MORE STEAM TAPPINGS

1. Steam Main.
2. Bleeder, 2 in. size
3. Return Header, 2 in.
4. Return Main, not less than 24 in. above water line.
5. Dunham Air Eliminator.
6. Dunham Air Check.
7. Swing Check Valve with Brass Disc.
8. Return Connection to Boiler 2 in. below water line.
9. End of Steam Main.
10. Dunham Trap No. 1A.
11. 10-in. Dunham Regulator Type 361.
12. Dunham Check Damper.
13. Hand Stop Damper.
14. Stop Cock.

Fig. 895B. Isometric View of Dunham Home Heating System



THE DUNHAM HOME HEATING SYSTEM (Continued)

TABLE 1. STEAM MAINS

Pipe sizes, in.	Capacities in square feet of direct cast iron radiation for each length				
	Length in feet				
	200.	300	400	500	600
2	320	282	248	218	200
2½	560	456	400	352	320
3	1000	810	710	625	570
3½	1500	1180	1035	910	830
4	2000	1640	1440	1270	1150
5	3600	2940	2580	2260	2060
6	5780	4700	4130	3640	3300

TABLE 2. RETURN MAINS

Pipe sizes.....	1 in.	1½ in.	2 in.	2½ in.
Capacity in sq. ft.....	300	1000	1700	3300

TABLE 3. STEAM MAIN DRIPS

Pipe sizes.....	1½ in.	2 in.	2½ in.
Capacity in sq. ft.....	1000	2000	6000

TABLE 4. RISER SIZES

Pipe sizes.....	Steam					Return
	¾ in.	1 in.	1½ in.	2 in.	2½ in.	¾ in.
*Length, 100 ft..	40	80	160	250	400	500
*Length, 200 ft..	25	55	115	175	320	320
*Length, 400 ft..	20	40	80	125	240	250

*The length equals the distance along piping from boiler to top of each riser plus allowance for elbows (Table 6) and plus 25 ft. allowance for last, or top, radiator connection.

Spring pieces, that is, connections from steam main to risers supplying second floor and up must always be made one size larger than the riser. Return spring pieces make same size as return riser.

TABLE 5. RADIATOR CONNECTIONS

Valves Type 105 or Type 145 with Regulating Plate—Top Inlet

Sq. ft. radiation	Supply			Return		
	Inlet valve, in.	Vertical pipe to inlet valve, in.	Horizontal runout from valve to spring piece to steam main from first floor radiator, in.	Trap No.	Stub to trap in.	Horizontal runout to return riser, in.
1-25	1½	1½	¾	1A	1½	¾
26-80	1½	1½	1	1A	1½	¾
81-100	1½	1½	1¼	1A	1½	¾
101-140	1½	1½	1¼	2B	1½	¾
141-170	1½	1½	1½	2B	1½	¾

Use pipes one size larger for horizontal steam connections, spring pieces and runouts, over 8 ft. long.

Grade horizontal connections, both steam and return, with a fall not less than ½ in. per foot.

TABLE 6. ALLOWANCES FOR RESISTANCE TO FLOW
In feet of pipe

Size.....	¾	1	1¼	1½	2	2½	3	3½	4	5	6	8	10	12	14OD	16OD
For elbows.....	2	2	2	3	5	6	9	10	14	19	24	35	47	59	70	82
For globe.....	2	2	2	3	5	6	9	10	14	19	24	35	47	59	70	82
Valves.....	2	3	3	5	7	9	14	15	21	28	36	53	70	88	106	124

In sizing the piping for any system of heating the length of the piping must be ascertained, and the frictional resistance of fittings and valves considered. It is customary to reduce these resistances to equivalent lengths of straight pipe which must be added to the actual length. In Table 6 these resistances are given in feet of pipe. An additional allowance of 25 ft. must be made for resistance to entrance to the radiator.

Specifications for Dunham Home Heating System

Articles 1 to 3 inclusive same as for Dunham Vacuum Return Line System, see Dunham Page 30.

(4) **Boiler**—The steam boiler shall be a.....with guaranteed rating for.....sq. ft. of direct radiation installed upon suitable foundation and in accordance with manufacturer's setting instructions. It shall be equipped with all necessary connections and trimmings including a safety valve set to blow at 10 lb. pressure, a Dunham Compound Gauge 10 lb. x 20 in. vacuum and a 10-in. Dunham Damper Regulator. (Omit Regulator on gas fired and automatic oil fired installations.) The boiler must be so installed that the distance between the normal boiler water line and the lowest return pipe shall be not less than 24 in. Furnish boiler pit if necessary to obtain this minimum distance.

(5) **Smoke Pipe**—Connect boiler to chimney with suitable iron smoke pipe same size as boiler smoke outlet. Smoke pipe must be provided with approved Dunham Check Damper and hand stop damper between check damper and boiler. (On gas and automatic oil fired installations omit Dunham Check Damper, omit hand stop damper on gas fired installations.)

(6) **Pipe and Fittings**—Furnish and erect with tight connections all necessary piping of sizes shown on plans and run as indicated, supported and properly graded to insure free and noiseless circulation. Use fittings of cast iron of standard quality. The ends of all pipes shall be reamed or filed. Proper provision must be made for expansion. Use graphite and oil for making up all pipe joints applied to male thread only.

(7) All steam tappings in boiler shall be connected full size of tapping into a steam header which shall be dripped to the return header through a bleeder. All spring pieces to steam and return mains shall be taken off the top of mains at 45 deg.

(8) The end of each steam main shall be dripped as indicated on the plans by means of a drip line to boiler, properly vented through Dunham Trap in accord with details furnished by manufacturer.

(9) Grade steam mains ½ in. in 10 ft. Grade return mains and drip mains 1 in. in 10 ft. All steam supply branches such as spring pieces, offsets in steam risers and runouts to radiators shall in each case be installed one size larger than the vertical pipes to which they connect and shall be given as much grade as possible. ½ in. per ft. is preferable.

(10) Furnish and install on return main in accordance with manufacturer's instructions a Dunham Air Eliminator. Install a Dunham Air Check on vent opening of Eliminator.

(11) Risers are to be run concealed or in the open as directed by the architect. All concealed piping must be tested and made tight at 15-lb. water pressure before being concealed and covered.

Articles 12 and 13, same as Dunham Page 30.

(14) **Thermostatic Control**—Contractor shall furnish and install according to manufacturer's instructions where shown on plans. Thermostat and Damper Motor of approved make.

Articles 15 and 16, same as Dunham Page 30.

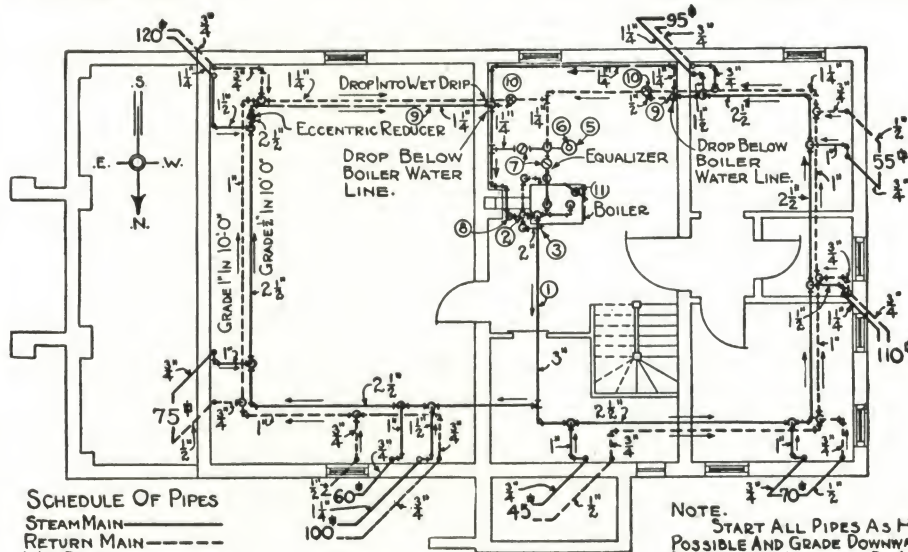
(17) **Radiator Traps and Valves**—Each radiator shall be provided with a Dunham Radiator Trap of suitable capacity. A Dunham Packless Radiator Valve with Dunham Regulating Plate shall be installed at inlet connection according to manufacturer's instructions. The plates shall not be inserted in the valves until after the system has been cleaned.

Articles 18, 19 and 20, same as Dunham Page 30.

(21) **Test**—The System when finished and cleaned shall be tested for tightness by filling it with water to its very top. The water shall be left standing in the system until all leaks have been made tight. The contractor must take precaution to guard against damage from freezing during test.

(22) **Guarantee**—The Heating Contractor shall guarantee the apparatus installed to circulate steam thoroughly through every radiator without noise, under a steam pressure on the heating mains not to exceed ½-lb. gauge. If the apparatus shall fail to accomplish this guarantee by reason of any defect developing within the period of one full heating season, and that defect is due to faulty material or poor workmanship, the Heating Contractor shall remedy such defect at his own cost within reasonable time after notice thereof.

(23) **Finally**—Nothing herein contained can be construed to relieve the Heating Contractor from making good and perfect work in all usual details of construction and he will be held responsible to provide and furnish necessary material and to perform all necessary labor and to bear all expenses incidental to the satisfactory completion of the work.



SCHEDULE OF PIPES
STEAM MAIN.....
RETURN MAIN.....
WET DRIP.....
DRY DRIP.....

BASEMENT FLOOR PLAN

Fig. 873B. Heating Plan for Home Heating System. See Fig. 960C, Dunham Page 33, for Parts Indicated by Number

"DUNHAMIZING" RADIATORS FOR ANY TYPE OF STEAM HEATING SYSTEM

The Dunham Packless Radiator Valve and the Dunham Radiator Trap

Any system of steam heating can be made more efficient by installing Dunham Radiator Traps and Dunham Packless Valves with Regulating Plates on the radiators. The Dunham Packless Valve assures unfailing control of the supply of incoming steam and the Dunham Trap insures free exit of air and water but retention of the steam. Noise, air fouling and leakage are unknown on a "Dunhamized" radiator.

The Dunham Packless Radiator Valve

This valve is really "packless." Neither packing of any kind nor any springs are used in its construction. It is built in two specific styles. All valves meet the roughing-in requirements of the Heating & Piping Contractors National Association.

The lever handle valve is furnished in angle pattern only and recommended for radiators with top inlet connection in keeping with the most approved modern steam heating practice. The low bonnet is an attractive feature of this valve. The wheel handle valve can be used on any steam system and is furnished in angle pattern, straightway pattern, right hand pattern and left hand pattern.

Look for the
name
DUNHAM



Only the best of materials are used. Both types are neat in appearance, and are quick opening and closing valves. The valve is made packless by means of the bellows construction, consisting of a series of corrugated phosphor bronze diaphragms which permit the free up and down movement of the spindle and valve disc. This construction obviates the use of springs, packing or stuffing boxes of any kind and entirely prevents the leakage of steam, air or water. The prevention of leakage of air into the radiators is an important factor, for leakage will destroy the vacuum when operating on a declining fire. The holding of vacuum is an important factor in economical operation because it prolongs the heating period between firings. It has the advantage that no steam, water or dirt can come in contact with the thread of the valve spindle. The importance of this will be appreciated. It assures easy turning of handle at all times. The construction prevents leakage of steam and water into the room, marring the walls, furnishings or floors.

Complete specifications are given on Dunham Pages 39, 40, 41 and 42.

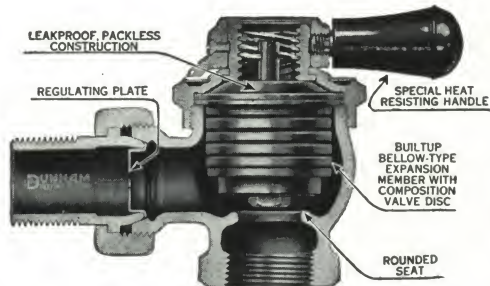
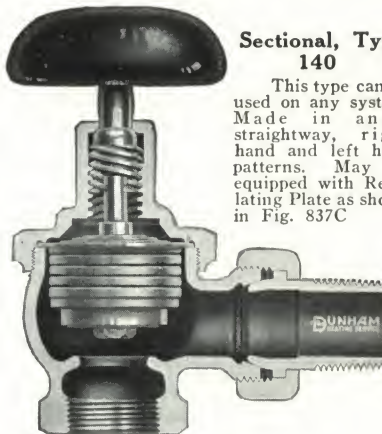


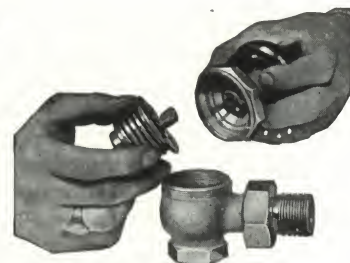
Fig. 837C.

Sectional Type 100
Made only in angle pattern
Regulating Plates are shipped separately



Sectional, Type 140

This type can be used on any system. Made in angle straightway, right hand and left hand patterns. May be equipped with Regulating Plate as shown in Fig. 837C



Showing Simplicity of Assembly of Type 140 Valve

Wearing qualities and interchangeability of parts are most vital. Interchangeable parts combine long life, with final renewals of the working part at a minimum cost and inconvenience

Fig. 877B

The Dunham Regulating Plate

By means of the Dunham Regulating Plate (Type 192) the correct proportion of vapor necessary to properly heat each radiator is provided.

It is particularly advantageous on the Dunham Differential System and the Dunham Home Heating System and wherever vapor is used as heating medium.

The plate is inserted in the union of the valve, the plate orifice being calibrated to the number of square feet of radiation in each radiator.

The use of the Dunham Regulating Plate simplifies many

things which have been serious barriers to progress in the art of heating, *for without this plate* the resistance which vapor encounters in flowing from the boiler to the radiator cannot be the same for each radiator.

The resistance opposing the flow of condensate and air from the radiator to the boiler is not uniform for each radiator without this plate because the opening through which the vapor flows to each radiator is not closely proportioned to the supply required by the radiator.

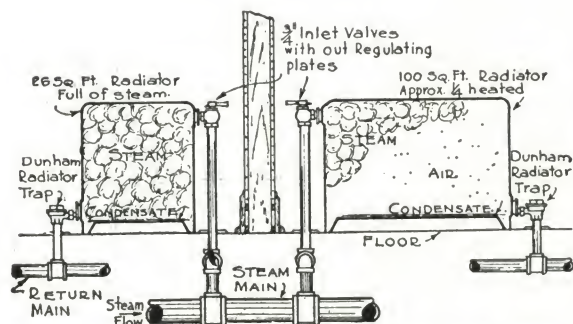


Fig. 893. Inlet Valve Without Regulating Plate



Type 192 Regulating Plate

The regulating plate can be furnished (without additional charge) for any valve listed in the following pages

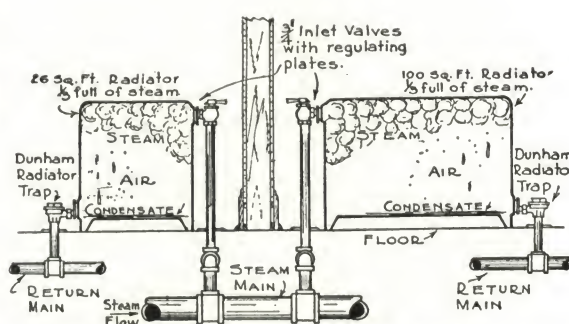


Fig. 894. Inlet Valve with Regulating Plate

Under either pressure or vacuum conditions, a 26 sq. ft. radiator should heat no more rapidly than a 100 sq. ft. radiator irrespective of the relative location of the two with reference to the boiler. In actual practice, and with no provision for interposing resistance to the steam flow, there will be irregularity in heating each respective radiator.

During the milder days of the heating season, there are times when a radiator should give off only a fraction of the heat required under cold weather conditions. To secure this result, a lower vapor pressure is often carried on the steam main; but the tendency in such cases in the ordinary system (as shown in Fig. 893, Dunham Page 35) is for the radiators closest to the boiler to take more than their proportion of the vapor, and thus prevent sufficient vapor from reaching radiators in parts of the building remote from the boiler.

Interposing the regulating plates evens up this inequality

of flow to each radiator when starting up the system.

With the regulating plate in use, the radiators of the system will fill with vapor evenly and make possible the correction of unbalanced condition in the piping system. See Fig. 894. The regulating plate will *distribute the vapor uniformly under every pressure condition*. There will be an increased operating economy and tendency to uniform regulation of the temperature by variation of steam pressure.

The radiators closest to the boiler will take only a fraction of what they would receive with the regulating plate omitted, and the steam will be uniformly distributed throughout the piping without noticeable friction except at the orifice opening. Because of this there will be less trouble arising should there happen to be a slight discrepancy in the steam pipe sizes. The steam main functions with the steam space of the boiler as a reservoir.

The Dunham Radiator Trap

The Dunham Trap for over twenty-five years has led in quality and in service. Its function is to conserve heat, and thus fuel, by keeping radiation and piping at the point of maximum efficiency by automatically permitting air and water to pass from the radiator without passing steam.

The Dunham Thermostatic Trap consists of two major parts—a body, and a cover. In the cover the operating member, the Dunham Thermostatic Disc, is securely placed. It has an exceptionally large valve opening. There are no detached loose parts in the path of flow, no sliding contacts to gum up, and no guide or pin to obstruct the valve opening or cause the valve to wear unevenly. The position and design of the valve are such that it is self-cleaning, and the closing of the trap will be tight even where the water is high in incrustants which deposit on the interior of the piping. The action of the disc is positive and the floating valve seats squarely, like a globe valve, the tightest of all types of valves. All of its working parts are made of non-corrosive material, of the best quality and kind, which gives the best service.

The wearing qualities of the Dunham Trap are further insured because of its construction. The Thermostatic Disc is constructed of two corrugated members made of special composition phosphor bronze, formed under pressure. The curves of the corrugations are designed to distribute the motion of the disc uniformly and to secure maximum movement with minimum stress in each portion of the disc. The disc contains a volatile fluid compounded to

insure uniform operation over a wide range of temperatures. This fluid is hermetically sealed in the disc. The disc is permanently adjusted in the cover at our factory and its setting should not be changed since it adjusts itself to all temperatures and pressures.

The Dunham Thermostatic Trap saves fuel by eliminating the air from the radiators and by holding the steam therein until it has given up all its heat.

The disc is subject to the same conditions of pressure and temperature that exist within the radiator, and its operation is controlled by these conditions.

As steam enters a cold radiator it forces the cool air which is in the radiator out through the trap into the return piping. In warming the radiator, the steam gives off heat and in doing so condenses to water. The water which is heavier than steam falls to the bottom of the radiator and flows to the trap through which it also passes into the return piping. After forcing out the air the steam fills the radiator and follows the water to the trap which, in the presence of steam, automatically closes because the steam is hotter than either the air or water. The heat of the steam vaporizes the fluid within the disc and creates a vapor which ex-

pands the disc, closing and holding the valve against its seat with a positive pressure, thus trapping the steam within the radiator.

The radiator now thoroughly filled with steam gives off heat, condensing the steam at a uniform rate, and the water of condensation which is cooler than the steam flows in a steady stream to the trap, which it slightly cools, causing it to open, allowing the water to pass out.

Look for the
name
DUNHAM



DUNHAM
Radiator Traps
bear
the name
Dunham

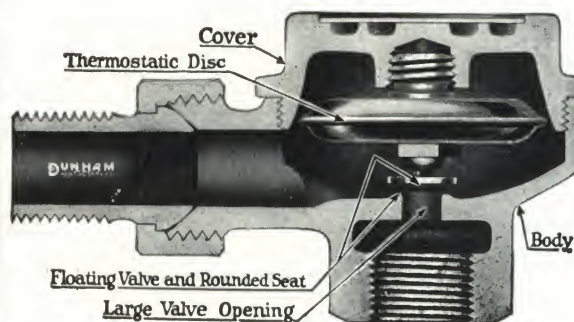


Fig. 819. Sectional View of Trap, Showing Simplicity of Construction

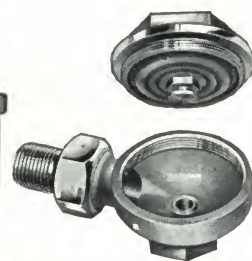


Fig. 800A. The Two Parts of the Radiator Trap

A simplicity of construction that combines long life without maintenance or trouble

Steam entering—air passing out through trap. Regulating Plate in valve allots the steam evenly to each radiator so each heats alike over the entire system

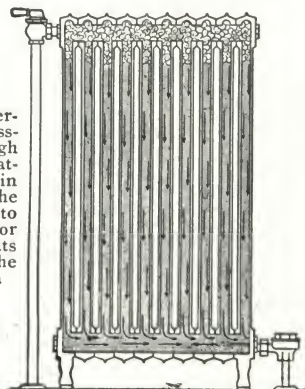


Fig. 802A

More steam entering—water (steam condensed from chill of radiator) and balance of air passing out through trap

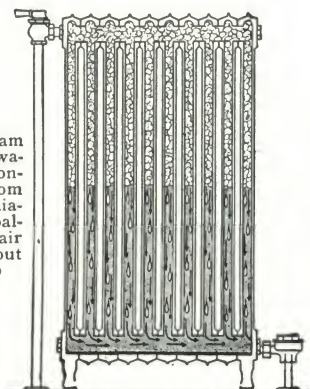


Fig. 803A

Radiator full of steam and hot all over and under any degree of vacuum or pressure within its operating range. Dunham Trap allows free passage of air and water, does not allow the escape of steam

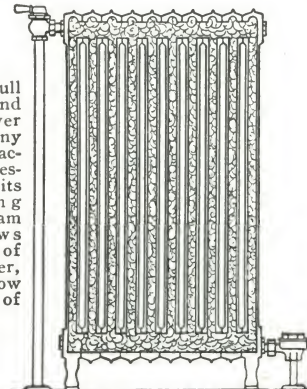


Fig. 804A

TYPICAL RADIATOR CONNECTIONS

Any type of radiation may be used. The return connection may be made at either end as shown. The Dunham Radiator Trap may be obtained in angle, straightway, right hand and left hand patterns for convenience in piping. Give all runouts plenty of grade— $\frac{1}{2}$ in. per ft. insures good flow. Full provision for riser expansion must be made and allowed for in the grading of runouts. Spring piece connections must be given especially good grade. See Figs. 872 and 900 on Dunham page 29.

In applying Dunham Traps to pipe coils they should be installed as indicated. A scale pocket is provided at the bottom of the return header and in front of the trap.

When a Dunham Thermostatic Trap is used for dripping steam piping it should be installed with at least 4 ft. of connecting piping between it and the point dripped. A liberal scale pocket should be provided,

also a gate valve and strainer in the connection to any drip trap. Scale pockets should never be smaller than a 2 in. pipe, with 3 in. (pipe) on large and long mains. Pockets should be 10 in. or more deep, as large space is necessary for collection of dirt.

When used for dripping the end of a steam main, the main should extend not less than 18 in. beyond the last riser connection and be provided with a scale pocket.

Down-feed risers require individual drips and traps. The trap should be installed as illustrated. The No. 3 Dunham Trap is preferable for this service within its capacity.

Nos. 1A and 2B Traps conform to the standard dimension "A," ($3\frac{1}{4}$ in.) adopted by the Heating and Piping Contractors' National Association for $\frac{1}{2}$ -in. traps.

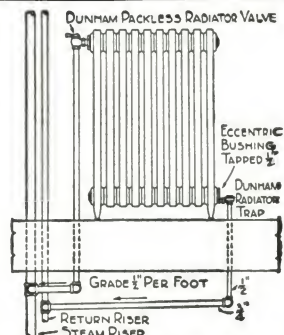


Fig. 807B. Runouts Below Ceiling

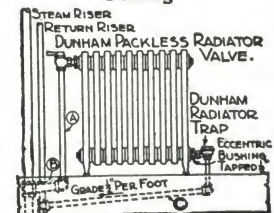


Fig. 809B. Runouts Between Floor and Ceiling

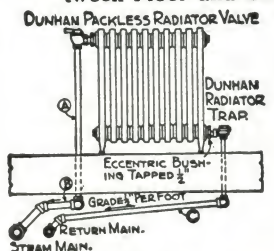


Fig. 810B. Trap and Valve at Same End of Radiator

Column radiators only, not to exceed 15 sections. Recommended for upper floors in small buildings to simplify piping

Fig. 813A. Spring Pieces and Radiator Connections for First Floor Radiator

General Note: Grade all horizontal spring pieces and runouts not less than $\frac{1}{2}$ in. per ft.

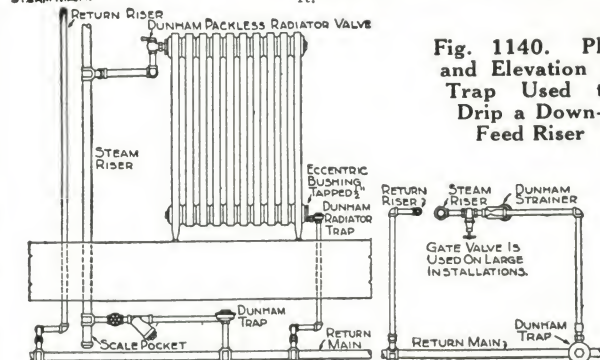


Fig. 1140. Plan and Elevation of Trap Used to Drip a Down-Feed Riser

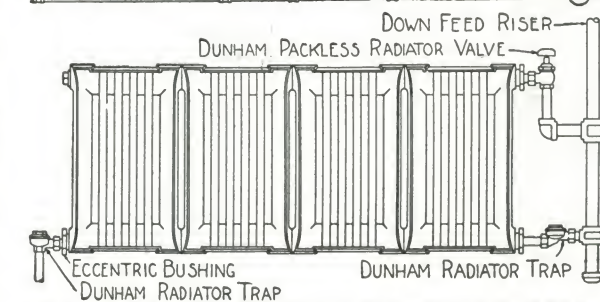


Fig. 969. Method of Dripping Short Down-feed Risers Through a Dunham Trap Into the Radiator

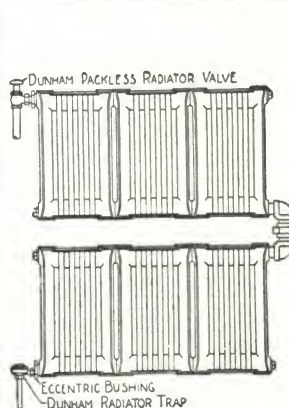


Fig. 946. Method of Connecting Wall Radiators When Installed in Tiers

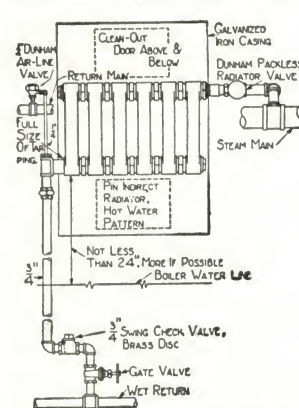


Fig. 902B. Connections to Indirect Radiator Located Below Return Main Using Dunham Air Line Valve

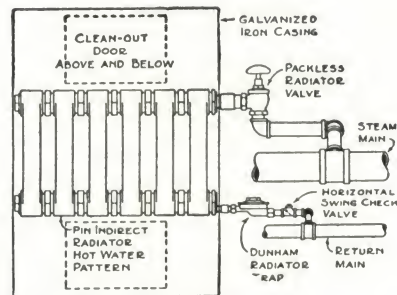


Fig. 903. Trap and Valve on Indirect Radiator

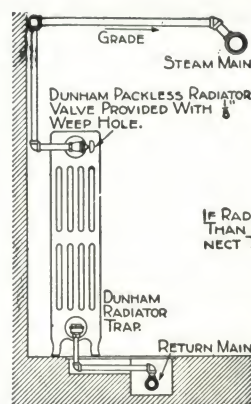


Fig. 839A. Overhead Supply, Valve Horizontal

The valve when used on above installation will be provided with an $\frac{1}{8}$ -in. weep-hole through the valve seat in order to provide drainage of condensate through valve when it is closed

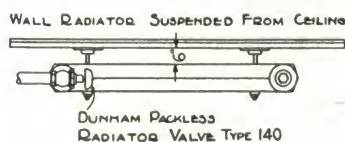
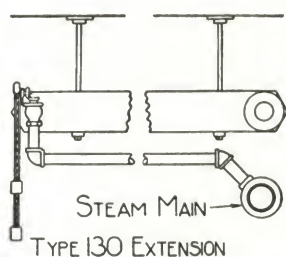
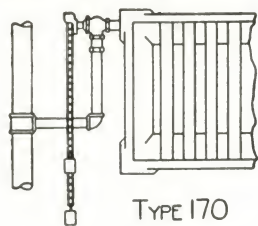


Fig. 841A. Typical for Wall Radiator Suspended from Ceiling

TYPICAL RADIATOR CONNECTIONS (Continued)



RADIATOR OR COIL ON CEILING

RADIATOR SUPPORTED HIGH
ON WALL OR IN SKYLIGHT

Typical Wall Coil Connections

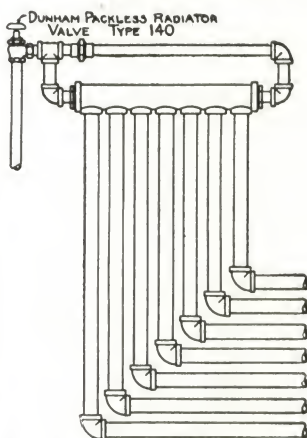
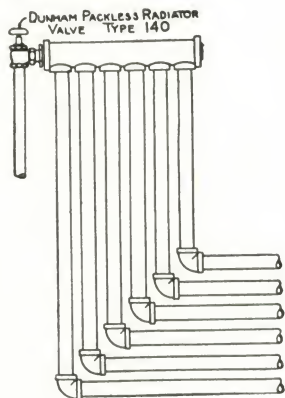
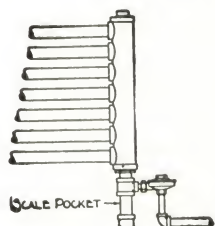
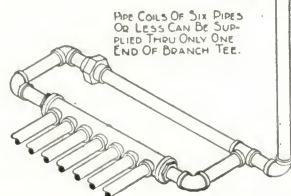
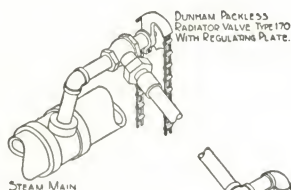
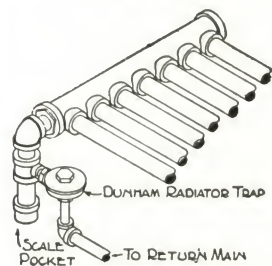
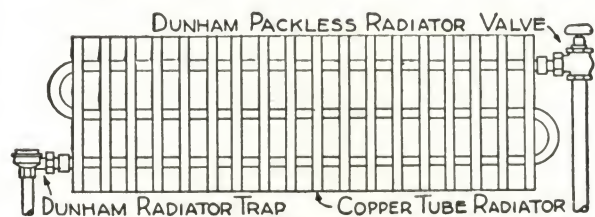
Fig. 816A. Supply Connections
to Coils of Seven
Pipes or MoreFig. 817A. Supply Connections
to Coils of Six
Pipes or LessFig. 811. Trap Used
on Wall CoilFig. 1123. Connections to
Pipe Coil on Ceiling with
Swing Connection and
Valve Permitting Oper-
ation from FloorFig. 812. Trap Used on
Ceiling Coil

Fig. 1207. Copper Tube Radiator Connections

Radiator Bottom Inlet

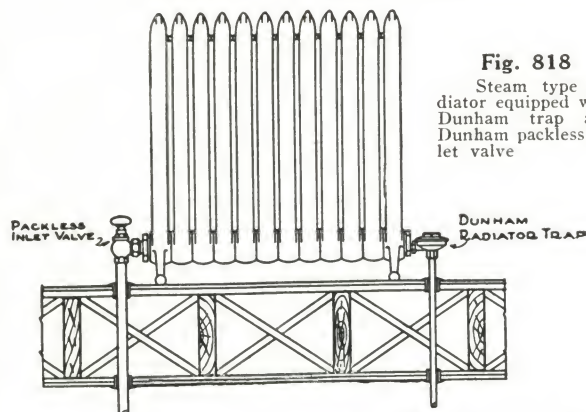


Fig. 818

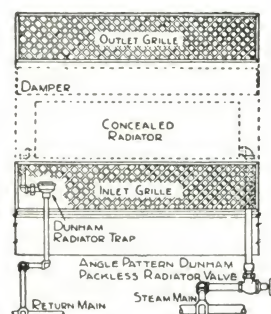
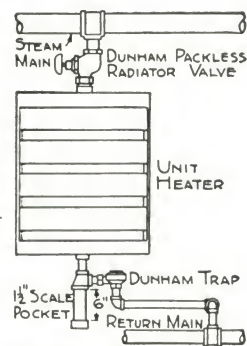
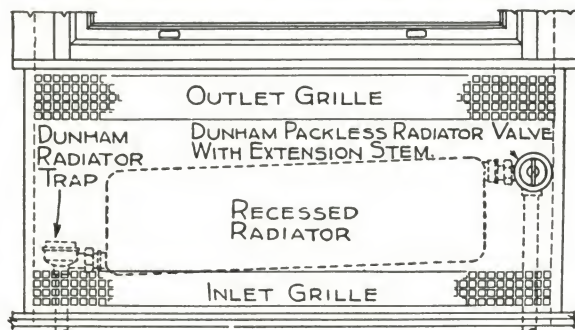
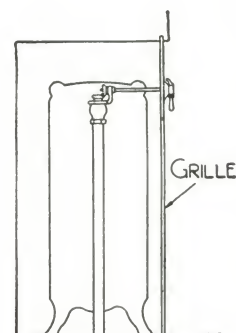
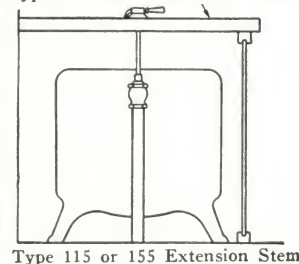
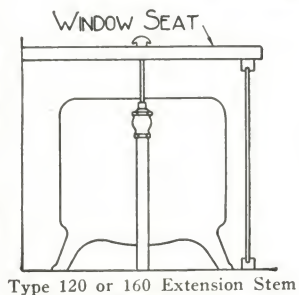
Steam type ra-
diator equipped with
Dunham trap and
Dunham packless in-
let valveFig. 1208A. Concealed Ra-
diator Unit ConnectionsFig. 1209. Suspended Unit
Heater Connections

Fig. 1206. Recessed Radiator Connections

Dunham extension
stem packless radiator
valves for enclosed win-
dow type radiators

CAPACITIES AND DIMENSIONS OF DUNHAM PACKLESS RADIATOR VALVES

Any Dunham Packless Radiator Valve Listed in This Catalogue Can Be Supplied with Regulating Plate Type 192 Without Extra Charge, See Dunham Pages 35 and 36

Capacities and Radiator Connections Where Regulating Plates Are NOT Used

On two-pipe systems, the following schedule is recommended. (Where Regulating Plates are used see tables under Types 105 and 145.)

Square feet direct radiation	Supply		
	Inlet valve, in.	Vertical pipe to inlet valve, in.	Horizontal runout to riser, or the spring-piece to main from a first floor radiator, inches
1-25	1/2	1/2	3/4
26-80	3/4	3/4	1
81-100	3/4	3/4	1 1/4
101-140	1	1	1 1/4
141-180	1	1	1 1/2
181-300	1 1/4	1 1/4	1 1/2
301-450	1 1/2	1 1/2	2
451-700	2	2	2 1/2

Use pipes one size larger for horizontal connections over 8 ft. long. Grade horizontal connections with a fall not less than 1/2 in. per ft.

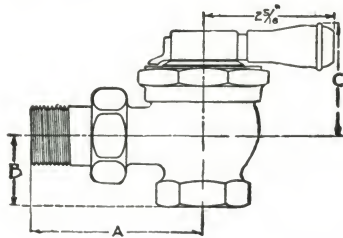


Fig. 838B

Type 100, Lever Handle

This valve, stocked in angle pattern only, is designed for use on radiation having top inlet connection for steam heating work on pressures not exceeding 25 lb. gauge.

Shorter handle for wall type radiators furnished upon request.

Size, in.	Net wt., lb.	Dimensions in inches			List price	Code
		A	B	C		
1/2	1 1/2	3	1 1/8	1 15/16	\$ 6.30	Trapeze
3/4	1 3/4	2 7/8	1 1/4	1 15/16	7.20	Trapezoid
1	2 1/4	3 1/8	1 1/2	2 1/8	9.00	Trapezium
1 1/4	3	3 3/4	1 5/8	2 5/8	11.00	Travail
1 1/2	4	3 3/4	1 5/8	2 3/4	13.50	Trave

Rough body, nickelplated, with polished trimmings.

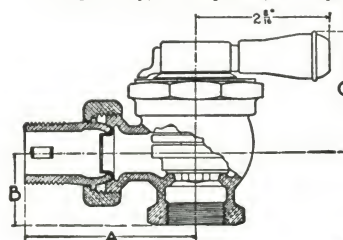


Fig. R-838B

Type 105, Lever Handle, and Regulating Plate

Rough body nickel plated with polished trimmings stocked in angle pattern only. Shorter handle for wall type radiators furnished upon request.

Size, in.	Cap. Sq. ft. direct rad.	Net wt., lb.	Dimensions, in.			List price inc. reg. plate	Code
			A	B	C		
1/2	1-25	1 1/2	3	1 1/8	1 15/16	\$6.30	Trapan
3/4	26-170	1 3/4	2 7/8	1 1/4	1 15/16	7.20	Trapereg

FOR RADIATORS WITH TOP INLET ONLY—USE THESE PIPE AND VALVE SIZES

Square feet direct radiation	Supply		
	Inlet valve, in.	Vertical pipe to inlet valve, in.	Horizontal runout to riser, or the spring-piece to main from a first floor radiator, in.
1-25	1/2	1/2	3/4
26-80	3/4	3/4	1
81-140	3/4	3/4	1 1/4
141-170	3/4	3/4	1 1/2

General Notes

For capacities and size of radiator connections when Regulating Plate is used, see tables beneath Fig. R838B at left and Fig. R915A page 41 for Types 105 and 145.

For convenience in ordering we have assigned Type 105 to Type 100 1/2-in. and 3/4-in. valves and Type 145 to Type 140 1/2-in. and 3/4-in. valves when Regulating Plate is to be included. For all other valves of any type give regular type number, size of valve and state that Regulating Plate is desired.

When ordering Regulating Plates, in addition to giving valve sizes always give a list of the radiator sizes.

Use pipes one size larger for horizontal connections over 8 ft. 0 in. long. Grade horizontal connections with a fall not less than 1/2 in. per foot.

Type 110, Lock and Shield

This valve, stocked in angle pattern only, is designed for use on radiation having top inlet connection for steam heating work.

Key for opening valve, 30 cents net. When ordering, specify valve type number.

Rough body, nickelplated, with polished trimmings.

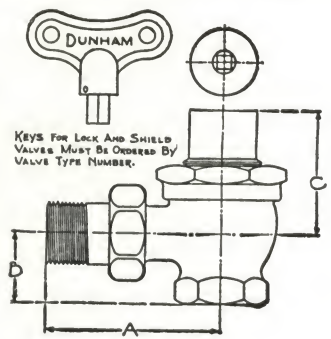


Fig. 910A

Size, in.	Net wt., lb.	Dimensions in inches			List price	Code
		A	B	C		
1/2	1 1/2	3	1 1/8	2 1/8	\$ 7.30	Twattle
3/4	1 3/4	2 7/8	1 1/4	2 1/8	8.20	Tweak
1	2 1/4	3 1/8	1 1/2	2 5/8	10.00	Tween
1 1/4	3	3 3/4	1 5/8	2 1/2	12.00	Twig
1 1/2	4	3 3/4	1 7/8	2 15/16	14.50	Tweeze

Type 115, Lever Handle, Plain Extension Stem

This valve, stocked in angle pattern only, is designed for use on radiation having top inlet connection for steam heating work, for radiators behind grilles or under seats of such design that valve handle can be placed directly above the valve. Fasten the plate (under handle) to wood-work or grille with three 1/8-in. flat-head screws or bolts. Screws or bolts not included in price.

A standard extension stem of 12 in. is furnished. Stem may be cut on installation for shorter lengths. Greater length than 12 in. will be supplied at no extra charge, upon order.

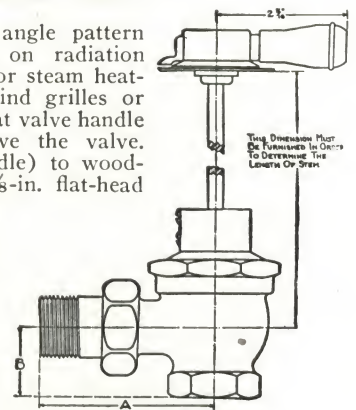


Fig. 911A

Size, in.	Net wt., lb.	Dimensions in inches		List price	Code
		A	B		
1/2	2	3	1 1/8	\$ 8.70	Twins
3/4	2 1/4	2 7/8	1 1/4	9.60	Twinkle
1	2 3/4	3 1/8	1 1/2	11.40	Twirl
1 1/4	3 1/2	3 3/4	1 5/8	13.40	Twist
1 1/2	4 1/2	3 3/4	1 7/8	15.90	Twitch

Rough body, nickelplated, with polished trimmings.

CAPACITIES AND DIMENSIONS OF DUNHAM PACKLESS RADIATOR VALVES (Continued)

Type 120, Flush Type Handle, Extension Stem

This valve, stocked in angle pattern only, is designed for use on radiation having top inlet connection for steam heating work and for radiators under seats. The low bonnet permits a very short extension in cases where room for installation is limited. The cup (beneath handle) is to be counter-sunk level with top of seat. Fasten it to seat with No. 4 wood screws. Screws not included in price.

A standard extension stem of 12 in. is furnished. Stem may be cut on installation for shorter lengths. Greater length than 12 in. will be supplied at no extra charge, upon order.

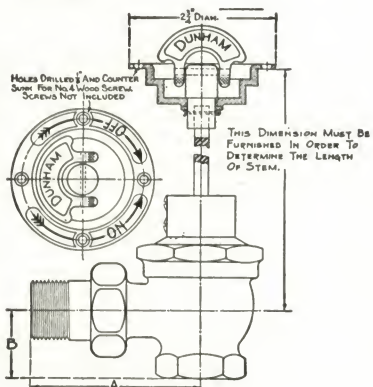


Fig. 912B

Size in.	Net wt. lb.	Dimensions in inches		List price	Code
		A	B		
1/2	2 1/4	3	1 1/8	\$ 8.70	Tyalt
3/4	2 3/4	2 7/8	1 1/4	9.60	Tyburn
1	2 3/4	3 1/8	1 1/2	11.40	Tycoon
1 1/4	3 1/2	3 3/8	1 5/8	13.40	Tying
1 1/2	4 1/4	3 3/4	1 7/8	15.00	Tyler

Rough body, nickel plated, with polished trimmings.

TYPE 130

Size in.	Net wt. lb.	Dimensions in inches			List price	Code
		A	B	C		
1/2	2 3/4	3	1 1/8	3 13/16	\$12.90	Udder
3/4	3	2 7/8	1 1/4	3 13/16	13.80	Ugly
1	3 1/2	3 1/8	1 1/2	4	15.60	Ugic
1 1/4	4 1/4	3 3/8	1 5/8	4 3/8	17.60	Uhlan
1 1/2	5 1/4	3 3/4	1 7/8	4 7/8	20.10	Ukase

Type 125, Lever Handle, Geared Extension Stem

This valve, stocked in angle pattern only, can be used on radiation having top inlet connection for steam heating work, for radiators behind grilles or under seats with the handle located on front of grille or seat.

Fasten the plate (under handle) to wood-work or grille with three 1/8-in. flat-head screws or bolts. Screws and bolts not included in price.

A standard extension stem of 12 in. is furnished. Stem may be cut on installation for shorter lengths. Greater length than 12 in. will be supplied at no extra charge, upon order.

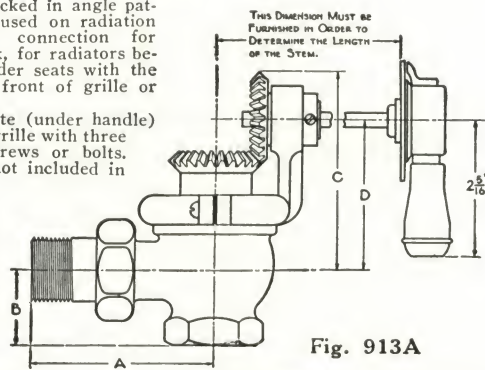


Fig. 913A

Size in.	Net wt. lb.	Dimensions in inches				List price	Code
		A	B	C	D		
1/2	2 1/4	3	1 1/8	3 3/8	2 3/16	\$12.90	Typhoid
3/4	2 3/4	2 7/8	1 1/4	3 3/8	2 9/16	13.80	Typhoon
1	3	3 1/8	1 1/2	3 3/8	2 3/4	15.60	Tyrist
1 1/4	3 3/4	3 1/2	1 5/8	3 3/4	2 15/16	17.60	Typog
1 1/2	4 1/4	3 3/4	1 7/8	4 1/8	3 1/4	20.10	Tyrant

Rough body, nickel plated, with polished trimmings.

TYPE 170

Size in.	Net wt. lb.	Dimensions in inches			List price	Code
		A	B	C		
1/2	2 1/2	3	1 1/8	3 5/16	\$12.90	Unborn
3/4	2 5/8	2 7/8	1 1/4	3 1/2	13.80	Unbraid
1	3 1/8	3 1/8	1 1/2	3 3/8	15.60	Uncage
1 1/4	4 1/8	3 1/2	1 5/8	3 7/8	17.60	Uncanny
1 1/2	4 7/8	3 3/4	1 7/8	4 1/8	20.10	Uncap
2	6 3/8	4 3/8	2 1/4	5 1/4	25.70	Unchain

Type 130, Gear and Chain Valve

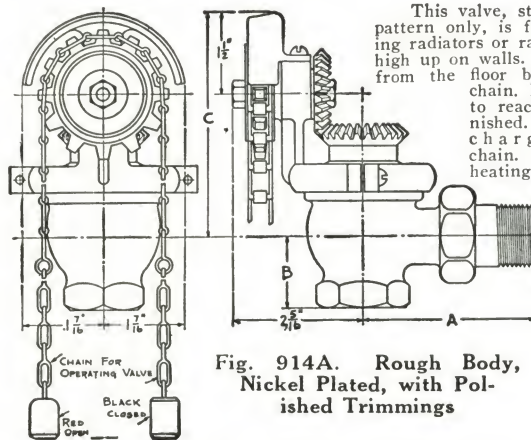


Fig. 914A. Rough Body, Nickel Plated, with Polished Trimmings

(See Dimensions Table in Column 1)

This valve, stocked in angle pattern only, is for use on ceiling radiators or radiators located high up on walls. It is operated from the floor by means of a chain. Length of chain to reach 5 ft. is furnished. No extra charge for longer chain. For steam heating work.

Type 170, Wheel and Chain Valve

The valve, stocked in angle pattern only, is designed for use on ceiling radiation or radiators located high up on walls. It is operated from the floor by means of chain. Standard length of chain to reach 5 ft. below valve is furnished; if longer chain is desired, state additional length required. No extra charge for longer chain.

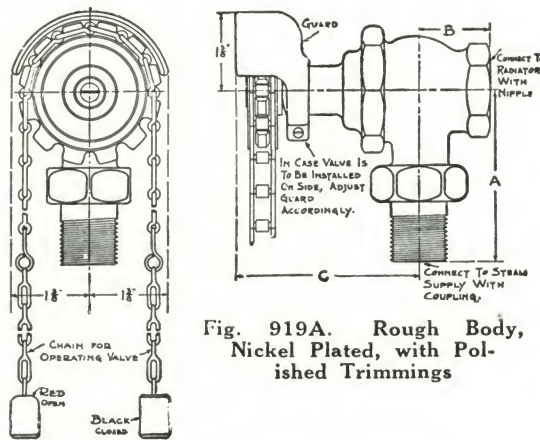


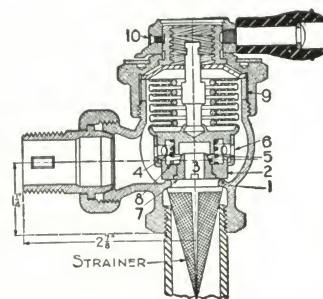
Fig. 919A. Rough Body, Nickel Plated, with Polished Trimmings

(See Dimensions Table in Column 1)

Type 180, Heat Control Valve

This valve is stocked in 3/4 in. size angle pattern only. Its net weight is 1 3/4 lbs. It is peculiarly suited for use with the Dunham Differential Heating System, and gives precise control of the individual radiators. It gives the room occupant the opportunity of reducing or increasing room temperatures to suit individual taste.

In the "cooler," "normal" and "warmer" positions the valve disc (2) is in contact with seat (1). The steam flows through the port (3) in regulating bushing (7), the governing flow area being that between seating surface (5) of regulating bushing and regulating valve seating surface (4). After passing this point the steam enters the radiator through openings in sleeve (6) and valve outlet. Spring (8) serves to hold the valve disc (2) in contact with seat (1), against the frictions of the parts, in each of these positions. In "Off" position the valve is in contact with seat owing to the thrust of the regulating valve.



DUNHAM PACKLESS RADIATOR VALVES (Continued)

Types 140, 141, 142, 143 Wheel Handle

This valve can be used on one-pipe or two-pipe steam heating work and for either hot water type or steam type radiation. The valve will be supplied, at no extra cost, with a $\frac{1}{8}$ -in. weep hole through valve seat in cases where short down weep risers are dripped through the valve into the radiator as shown in Fig. 839A, page 37.

Any size can be supplied with Regulating Plate but for convenience in ordering Type 140, $\frac{1}{2}$ -in. and $\frac{3}{4}$ -in. valves with Regulating Plate, it is assigned Type No. 145 as shown in opposite column.

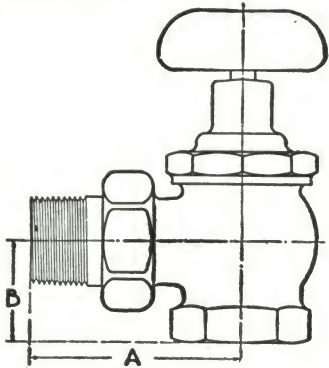


Fig. 921A
Angle Pattern

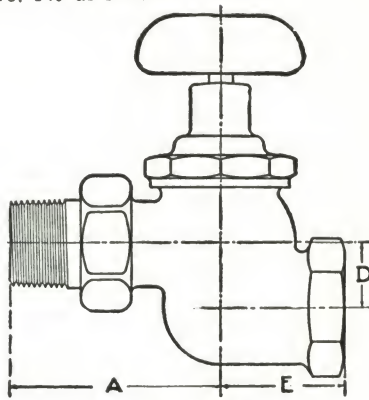


Fig. 922A

For S. W., R. H., L. H.

For R. H. and L. H. pattern valve, use same dimensions as straightway except inlet is located at right angles to outlet

Size, in.	Net weight, lb.		Dimensions in inches				List price
	Angle	SW.—RH. LH.	A	B	D	E	
$\frac{1}{2}$	1 $\frac{1}{8}$	1 $\frac{3}{4}$	3	1 $\frac{1}{8}$	$\frac{5}{8}$	1 $\frac{3}{8}$	\$ 6.30
$\frac{3}{4}$	1 $\frac{3}{8}$	2 $\frac{1}{4}$	2 $\frac{7}{8}$	1 $\frac{1}{4}$	$\frac{3}{4}$	1 $\frac{5}{8}$	7.20
1	2 $\frac{1}{4}$	2 $\frac{3}{4}$	3 $\frac{1}{8}$	1 $\frac{1}{2}$	1	1 $\frac{7}{8}$	9.00
1 $\frac{1}{4}$	3 $\frac{1}{4}$	3 $\frac{3}{4}$	3 $\frac{1}{2}$	1 $\frac{5}{8}$	1 $\frac{1}{8}$	2 $\frac{1}{16}$	11.00
1 $\frac{1}{2}$	4	5	3 $\frac{3}{4}$	1 $\frac{7}{8}$	1 $\frac{1}{4}$	2 $\frac{5}{16}$	13.50
2	5 $\frac{3}{4}$	6 $\frac{1}{4}$	4 $\frac{3}{8}$	2 $\frac{1}{4}$	1 $\frac{1}{2}$	2 $\frac{11}{16}$	19.10

Rough body, nickel plated, with polished trimmings.
Can be supplied with regulating plate without additional charge.
In ordering it is necessary to specify pattern.

Size, in.	Code			
	Angle type 140	Straightway type 141	Right hand type 142	Left hand type 143
$\frac{1}{2}$	Antawny	Sytawny	Ritawny	Letawny
$\frac{3}{4}$	Antepid	Sytopid	Ritpid	Letpid
1	Antidal	Sytidal	Ritidal	Letidal
1 $\frac{1}{4}$	Antoast	Sytoast	Ritoast	Letoast
1 $\frac{1}{2}$	Antunic	Sytunic	Ritunic	Letunic
2	Antwang	Sytwang	Ritwang	Letwang

Type 145, Wheel Handle and Regulating Plate

This is the $\frac{1}{2}$ in. and $\frac{3}{4}$ -in. Type 140 valve (shown in opposite column) but supplied with Regulating Plate when ordered under Type No. 145. Stocked only in angle pattern.

It is identically the same valve with the above exception and can be used on two-pipe steam heating work and for either hot water type or steam type radiation.

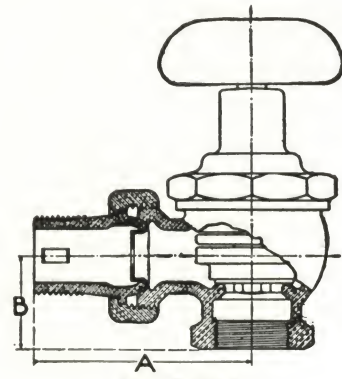


Fig. R915A

Size, in.	Capacity sq. ft. direct rad.	Net wt., lb.	Dimensions in inches		List price	Code
			A	B		
$\frac{1}{2}$	1-25	1 $\frac{5}{8}$	3	1 $\frac{1}{8}$	\$6.30	Antawnreg
$\frac{3}{4}$	26-170	1 $\frac{3}{4}$	2 $\frac{7}{8}$	1 $\frac{1}{4}$	7.20	Antepreg

When ordering, give list of radiator sizes in square feet so that correct regulating plate may be shipped. Regulating plate should not be installed in valve until after heating system has been blown off and is clean.

For Valve Type 145 use following pipe sizes.

Square feet direct radiation	Supply		
	Inlet valve, in.	Vertical pipe to inlet valve, in.	Horizontal runout to riser, or the spring- piece to main from a first floor radiator, in.
1-25	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{3}{4}$
26-80	$\frac{3}{4}$	$\frac{3}{4}$	1
81-140	$\frac{3}{4}$	$\frac{3}{4}$	1 $\frac{1}{4}$
141-170	$\frac{3}{4}$	$\frac{3}{4}$	1 $\frac{1}{2}$

Use pipes one size larger for horizontal connections over 8 ft. 0 in. long.

Grade horizontal connection with a fall not less than $\frac{1}{2}$ -in. per foot.

Types 150, 151, 152, 153 Lock and Shield

This valve can be used on one-pipe or two-pipe steam heating work and for either hot water type or steam type radiation.

Key for opening valve, 30 cents net. When ordering, specify valve type number and also state which size key is required.

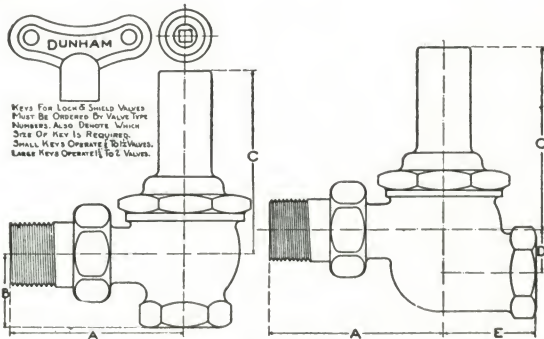


Fig. 916A

For R. H. and L. H. Patterns, use same dimensions as straightway except inlet is located at right angles to outlet

Small keys operate $\frac{1}{2}$ -in. to $1\frac{1}{4}$ -in. valves. Large keys operate $1\frac{1}{2}$ -in. to 2-in. valves.

Size, in.	Net wt., lb.		Dimensions in inches					List price
	Angle	SW. RH. LH.	A	B	C	D	E	
$\frac{1}{2}$	1 $\frac{3}{8}$	1 $\frac{3}{4}$	3	1 $\frac{1}{8}$	3 $\frac{3}{16}$	$\frac{5}{8}$	1 $\frac{3}{8}$	\$ 7.30
$\frac{3}{4}$	1 $\frac{5}{8}$	2	2 $\frac{7}{8}$	1 $\frac{1}{4}$	3 $\frac{3}{16}$	$\frac{3}{4}$	1 $\frac{5}{8}$	8.20
1	2 $\frac{1}{8}$	2 $\frac{3}{4}$	3 $\frac{1}{8}$	1 $\frac{1}{2}$	3 $\frac{19}{32}$	1	1 $\frac{7}{8}$	10.00
1 $\frac{1}{4}$	3	3 $\frac{1}{2}$	3 $\frac{1}{2}$	1 $\frac{5}{8}$	4 $\frac{19}{32}$	1 $\frac{1}{8}$	2 $\frac{1}{8}$	12.00
1 $\frac{1}{2}$	4 $\frac{1}{4}$	5 $\frac{1}{4}$	3 $\frac{3}{4}$	1 $\frac{7}{8}$	4 $\frac{3}{16}$	1 $\frac{1}{4}$	2 $\frac{5}{16}$	14.50
2	6	6 $\frac{1}{4}$	4 $\frac{3}{8}$	2 $\frac{1}{4}$	4 $\frac{7}{8}$	1 $\frac{1}{2}$	2 $\frac{11}{16}$	20.10

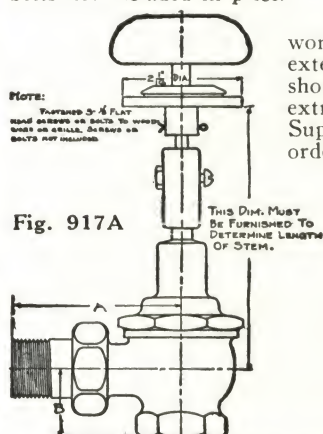
Rough body, nickel plated, with polished trimmings.
Can be supplied with regulating plate without additional charge.
In ordering it is necessary to specify pattern.

Size, in.	Code			
	Angle type 150	Straightway type 151	Right hand type 152	Left hand type 153
$\frac{1}{2}$	Anulcer	Syulcer	Riulcer	Leulcer
$\frac{3}{4}$	Anultimo	Syultimo	Riultimo	Leultimo
1	Anultra	Syutra	Riutra	Leutra
1 $\frac{1}{4}$	Anumbel	Syumbel	Riumbel	Leumbel
1 $\frac{1}{2}$	Anumberry	Syumberry	Riumberry	Leumberry
2	Anumbrage	Syumbrage	Riumbrage	Leumbrage

DUNHAM PACKLESS RADIATOR VALVES (Continued)

Types 155, 156, 157, 158, Wheel Handle, Plain Extension Stem

Recommended for radiators behind grilles or under seats of such design that valve handle can be placed directly above the valve. Fasten the plate (under handle) to woodwork or grille with three $\frac{1}{8}$ in. flat head screws or bolts. Screws and bolts not included in price.



These valves can be used on one-pipe or two-pipe steam heating work and for either hot water or steam type radiation. A standard extension of 12 in. is furnished. Steam may be cut on installation for shorter lengths. Greater lengths than 12 in. supplied on order at no extra charge. Rough body, nickel plated with polished trimmings. Supplied with Type 192 regulating plate at no additional charge. In ordering specify pattern.

DIMENSIONS OF TYPES 155, 156, 157, 158, 160, 161, 162 AND 163

Size, in.	Dimensions in inches			
	A	B	D	E
$\frac{1}{2}$	3	11 $\frac{1}{8}$	$\frac{5}{8}$	13 $\frac{1}{8}$
$\frac{3}{4}$	3 $\frac{1}{2}$	11 $\frac{1}{4}$	$\frac{3}{4}$	15 $\frac{1}{8}$
1	3 $\frac{1}{2}$	11 $\frac{1}{2}$	1	17 $\frac{1}{8}$
1 $\frac{1}{4}$	3 $\frac{1}{2}$	11 $\frac{3}{4}$	1 $\frac{1}{8}$	21 $\frac{1}{8}$
1 $\frac{1}{2}$	3 $\frac{1}{2}$	11 $\frac{3}{4}$	1 $\frac{1}{4}$	23 $\frac{1}{8}$
2	4 $\frac{3}{8}$	21 $\frac{1}{4}$	1 $\frac{1}{2}$	21 $\frac{1}{8}$

Types 160, 161, 162, 163, Flush Handle, Extension Stem

Recommended for radiators under seats. The cup (beneath handle) is to be counter-sunk level with top of seat. Fasten it to seat with No. 4 wood screws. Screws not included in price.

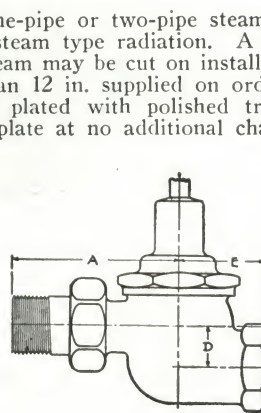


Fig. 918B

SIZES, WEIGHTS, LIST PRICES AND CODE FOR TYPES 155, 156, 157, 158, 160, 161, 162 AND 163

Size, in.	Net weight in lbs.				List price	Code for Types 155, 156, 157, 158				Code for Types 160, 161, 162, 163			
	Types 155, 156, 157 and 158		Types 160, 161, 162 and 163			Angle Type 155	Straightway Type 156	Right hand Type 157	Left hand Type 158	Angle Type 160	Straightway Type 161	Right hand Type 162	Left hand Type 163
	Angle	S.W. R.H. L.H.	Angle	S.W. R.H. L.H.									
$\frac{1}{2}$	21 $\frac{1}{8}$	21 $\frac{1}{4}$	11 $\frac{1}{8}$	21 $\frac{1}{8}$	\$ 8.70	Anumbrella	Syumbrella	Riumbrella	Leumbrella	Anunback	Syunback	Riunback	Leunback
$\frac{3}{4}$	21 $\frac{1}{4}$	21 $\frac{1}{2}$	21 $\frac{1}{8}$	21 $\frac{1}{2}$	9.60	Anunpire	Syunpire	Riunpire	Leunpire	Anunbar	Syunbar	Riunbar	Leunbar
1	21 $\frac{1}{2}$	21 $\frac{3}{4}$	21 $\frac{1}{2}$	21 $\frac{3}{4}$	11.40	Anunable	Syunable	Riunable	Leunable	Anunbated	Syunbated	Riunbated	Leunbated
1 $\frac{1}{4}$	3 $\frac{1}{4}$	4 $\frac{1}{4}$	3 $\frac{1}{2}$	4 $\frac{1}{2}$	13.40	Anunadvise	Syunadvise	Riunadvise	Leunadvise	Anunbelt	Syunbelt	Riunbelt	Leunbelt
1 $\frac{1}{2}$	4 $\frac{1}{2}$	5 $\frac{1}{2}$	4 $\frac{1}{4}$	5 $\frac{1}{4}$	15.90	Anunapt	Syunapt	Riunapt	Leunapt	Anunbind	Syunbind	Riunbind	Leunbind
2	6	6 $\frac{3}{4}$	5 $\frac{3}{4}$	6 $\frac{1}{2}$	21.50	Anunarmed	Syunarmed	Riunarmed	Leunarmed	Anunblest	Syunblest	Riunblest	Leunblest

DUNHAM THERMOSTATIC RADIATOR TRAPS

For Maximum Pressures of 15-lb. Gauge

Used principally in steam heating work. Installed on all forms and types of radiation and to risers for dripping purposes.

Maximum operating pressure is 15 pounds gauge, corresponding to limit set on low pressure heating boilers by the A.S.M.E. code. Must not be used on pressures exceeding 15 pounds.

Made in five sizes; are automatic in action within the fixed range of pressures and corresponding temperatures for which they are made. Need no adjusting upon installation. Each trap tested and adjusted before leaving factory. Adjustment must not be tampered with. Thermostatic disc must never, for any reason, be removed from the trap cover.

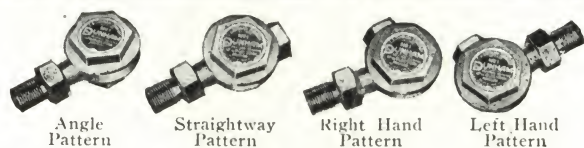


Fig. 867

SPECIFICATIONS AND PRICE LIST
(For pressures not exceeding 15 pounds gauge)

Size	Style	Tapping	Capacity direct radiation sq. ft.	Net weight	List	Code	Dimensions in in.				
							A	B	C	D	E
No. 1A	A.P.	$\frac{1}{2}$ inch	100	22 oz.	\$8.00	Atom	3 $\frac{1}{2}$	1 $\frac{1}{2}$	1 $\frac{1}{2}$	2 $\frac{1}{2}$	1 $\frac{1}{2}$
	S.W.	$\frac{1}{2}$ inch	100	22 oz.	8.00	Atude	3 $\frac{1}{2}$	1 $\frac{1}{2}$	1 $\frac{1}{2}$	2 $\frac{1}{2}$	1 $\frac{1}{2}$
	R.H.	$\frac{1}{2}$ inch	100	22 oz.	8.00	Attos	3 $\frac{1}{2}$	1 $\frac{1}{2}$	1 $\frac{1}{2}$	2 $\frac{1}{2}$	1 $\frac{1}{2}$
	L.H.	$\frac{1}{2}$ inch	100	22 oz.	8.00	Atwan	3 $\frac{1}{2}$	1 $\frac{1}{2}$	1 $\frac{1}{2}$	2 $\frac{1}{2}$	1 $\frac{1}{2}$
No. 2B	A.P.	$\frac{1}{2}$ inch	350	27 oz.	10.00	Abhor	3 $\frac{1}{2}$	1 $\frac{1}{2}$	1 $\frac{1}{2}$	3 $\frac{1}{2}$	1 $\frac{1}{2}$
	S.W.	$\frac{1}{2}$ inch	350	28 oz.	10.00	Abbey	3 $\frac{1}{2}$	1 $\frac{1}{2}$	1 $\frac{1}{2}$	3 $\frac{1}{2}$	1 $\frac{1}{2}$
	R.H.	$\frac{1}{2}$ inch	350	28 oz.	10.00	Abate	3 $\frac{1}{2}$	1 $\frac{1}{2}$	1 $\frac{1}{2}$	3 $\frac{1}{2}$	1 $\frac{1}{2}$
	L.H.	$\frac{1}{2}$ inch	350	28 oz.	10.00	Abyss	3 $\frac{1}{2}$	1 $\frac{1}{2}$	1 $\frac{1}{2}$	3 $\frac{1}{2}$	1 $\frac{1}{2}$
No. 3A	A.P.	$\frac{3}{4}$ inch	800	28 oz.	12.00	Alp	3 $\frac{5}{8}$	1 $\frac{3}{8}$	1 $\frac{3}{8}$	3 $\frac{1}{2}$	1 $\frac{1}{2}$
	S.W.	$\frac{3}{4}$ inch	800	30 oz.	12.00	Alper	3 $\frac{5}{8}$	1 $\frac{3}{8}$	1 $\frac{3}{8}$	3 $\frac{1}{2}$	1 $\frac{1}{2}$
	R.H.	$\frac{3}{4}$ inch	800	30 oz.	12.00	Alpine	3 $\frac{5}{8}$	1 $\frac{3}{8}$	1 $\frac{3}{8}$	3 $\frac{1}{2}$	1 $\frac{1}{2}$
	L.H.	$\frac{3}{4}$ inch	800	30 oz.	12.00	Alpest	3 $\frac{5}{8}$	1 $\frac{3}{8}$	1 $\frac{3}{8}$	3 $\frac{1}{2}$	1 $\frac{1}{2}$
No. 4A	A.P.	$\frac{1}{2}$ inch	1500	5 lbs.	18.00	Drink	2 $\frac{1}{2}$	2 $\frac{1}{2}$	3 $\frac{3}{4}$	5	1 $\frac{1}{2}$
	S.W.	$\frac{1}{2}$ inch	1500	5 lbs.	18.00	Drench	2 $\frac{1}{2}$	2 $\frac{1}{2}$	3 $\frac{3}{4}$	5	1 $\frac{1}{2}$
No. 5A	A.P.	1 inch	3000	6 lbs.	24.00	Drizzle	2 $\frac{5}{8}$	2 $\frac{5}{8}$	4	5	1 $\frac{1}{2}$
	S.W.	1 inch	3000	6 lbs.	24.00	Drift	2 $\frac{5}{8}$	2 $\frac{5}{8}$	4	5	1 $\frac{1}{2}$

The Nos. 1A and 2B Traps are used almost exclusively on radiators. The No. 3A Trap is used for large radiators, for medium sized pipe coils, and is adaptable for dripping risers and short runs of small steam piping. The Nos. 4A and 5A Traps are used where traps of large capacity are required on large pipe coils and blast heaters.

The Nos. 1A and 2B Traps conform with the standard dimension "A" ($3\frac{1}{4}$ in.) as adopted by the Heating and Piping Contractors' National Association for $\frac{1}{2}$ in. radiator traps.

The Nos. 1A, 2B and 3A Traps are regularly furnished nickelplated, and with union nut and nipple, threaded right hand. Supplied in all patterns. Bronze body and cover.

The Nos. 4A and 5A Traps are painted battle ship gray and furnished in either angle or straightway patterns with female right hand threaded connections, both inlet and outlet. Cast iron body and cover.

When not otherwise stipulated on order the regular Angle Pattern Traps of size called for will be shipped.

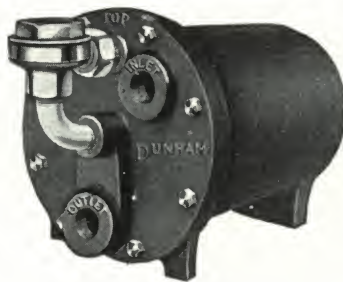


Angle Pattern Straightway Pattern Right Hand Pattern
Traps Nos. 1A, 2B and 3A
(Dimensions of Left Hand Pattern are the same as those of the Right Hand Pattern)
Fig. 805

THE DUNHAM FLOAT AND THERMOSTATIC TRAP

For Pressures Not Exceeding 15-lb. Gauge

These traps quickly handle large volumes of water on sudden calls for maximum duty. They open automatically for water and air and close for steam. They are suitable for either gravity or vacuum return line heating systems. The water is handled by the float valve, so constructed that the opening is always sealed with water with no opportunity for steam leakage. The air is handled by the thermostatic valve. They combine the Dunham Thermostatic Principle with the float. The thermostatic valve adjusts itself slowly like a thermometer to the temperature conditions present, while the float valve permits a continuous flow of water at a rate within its capacity limits, to keep the heaters or mains free from air and water, without waste of steam.



They may be applied to any type or make of cast iron or pipe coil blast heater. They are unsurpassed for dripping low-pressure steam mains and risers, vento heaters, unit heaters, blast coils, domestic hot water heaters, dry kilns, milk condensers, evaporators, paper machines and any industrial heater in which low pressure steam (not exceeding 15-lb. gauge) is used as a heating medium.

This type of trap not only drains the heater of its water of condensation but automatically releases the air, thus the highest possible heating efficiency is obtained, which results in the operation of the equipment at its maximum potential output.

In many industrial processes it is desirable to operate on a vacuum in the return line, a condition this is fully met in this type of trap.

Specifications and Price List

For Pressures Not Exceeding 15-lb. Gauge

Capacities given are based upon a condensation rate of $\frac{1}{4}$ lb. per sq. ft. of cast iron direct radiation per hour at a present difference of 1 lb. per sq. in. These capacities are maximum on heating installations, as the majority of these operate on small pressure differences. However, in connection with installation where the difference is constantly maintained greater, the capacity can be increased, as shown on Fig. 947D.

All traps have right-hand female tappings.

Trap No.	Size of tapping, in.	Cap. sq. ft. equi. dir. rad.	Net wt. lb.	Dimensions, inches							List price	Code
				A	B	C	D	E	F	G		
22C	$\frac{3}{4}$	3000	14	11 $\frac{1}{4}$	6 $\frac{3}{8}$	9 $\frac{1}{8}$	1 $\frac{5}{8}$	3 $\frac{1}{4}$	$\frac{3}{4}$	5 $\frac{1}{2}$	\$32.00	Bloater
23C	1	4000	15	11 $\frac{1}{4}$	6 $\frac{3}{8}$	9 $\frac{1}{8}$	1 $\frac{5}{8}$	3 $\frac{1}{4}$	$\frac{3}{4}$	5 $\frac{1}{2}$	36.00	Blockade
16C	$\frac{3}{4}$	6000	24	14 $\frac{1}{8}$	7 $\frac{1}{2}$	10 $\frac{1}{2}$	1 $\frac{5}{8}$	4 $\frac{1}{4}$	1 $\frac{1}{2}$	7 $\frac{1}{8}$	48.00	Blare
17C	1	7000	24	14 $\frac{1}{8}$	7 $\frac{1}{2}$	10 $\frac{1}{2}$	1 $\frac{5}{8}$	4 $\frac{1}{4}$	1 $\frac{1}{2}$	7 $\frac{1}{8}$	52.00	Blazon
18C	1 $\frac{1}{4}$	9000	33	15 $\frac{1}{2}$	9 $\frac{1}{8}$	12 $\frac{1}{2}$	2	4 $\frac{1}{2}$	1 $\frac{3}{4}$	9 $\frac{1}{2}$	64.00	Blest
19C	1 $\frac{1}{2}$	11000	33	15 $\frac{1}{2}$	9 $\frac{1}{8}$	12 $\frac{1}{2}$	2	4 $\frac{1}{2}$	1 $\frac{3}{4}$	9 $\frac{1}{2}$	68.00	Blithe
20C	2	16000	42	19 $\frac{1}{4}$	11 $\frac{1}{8}$	15 $\frac{1}{2}$	2 $\frac{1}{4}$	6 $\frac{1}{2}$	1 $\frac{3}{4}$	9 $\frac{1}{2}$	80.00	Blink

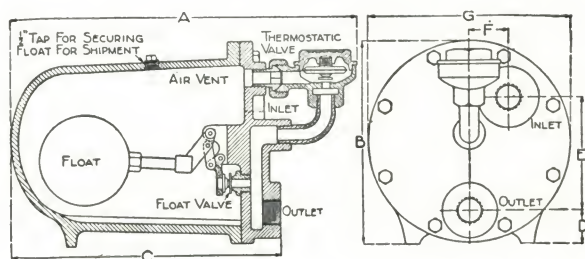


Fig. 1161A. Traps Nos. 16C, 17C, 18C, 19C and 20C

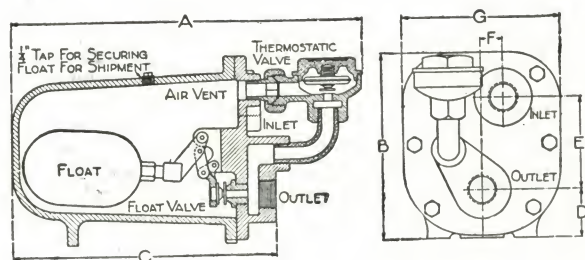


Fig. 1162A. Traps Nos. 22C and 23C

Capacities of Vento or Blast Heaters

The condensing capacities of blast heaters vary greatly with the service, the quantity and temperature of air to be handled, the velocity through the heater, etc. Each individual stack has a different rate of condensation, according to its position in the heater, subject also to the various conditions of service mentioned. It is therefore necessary that the condensing capacity of any heater, or in the case of individual stack connections, of any stack be carefully determined for each condition of service, and that the work done be reduced to units of equivalent square feet of direct radiation in order to select the proper trap and boiler capacity as well as steam and return pipe sizes. Considering a four-stack vento heater as a unit operating under average velocity conditions with inlet air at zero, its average rate of condensation per foot of heating surface will be from 6 to 8 times that of a direct radiator. Thus a superficial guide in selecting trap capacity would be to multiply the actual surface of the total heater by 6 or 8 and obtain an approximate of the equivalent heating surface in terms of square feet of direct radiation.

The manufacturers of the several commercial types of blast heaters give information as to how to determine the condensing rate in pounds of water per sq. ft. of their heaters under varying conditions.

The accompanying illustrations will show the proper methods of installation for vento heaters, and give the general idea of how the piping must be installed. Special details will gladly be furnished upon application showing connections to any other heater.

In applying these traps to vento heaters the supply and return connections must be at opposite ends of each stack. Where stacks are made up of 17 or more sections take an additional vent out of center vento section of each stack in heater using Dunham No. 1A Trap as shown. The Float and Thermostatic Traps may be installed in battery, or individually to each vento stack and connected as shown on following pages. When used individually the condensing rate of each stack must be independently determined in terms of equivalent direct radiation and ample trap capacity furnished. It must be remembered that the condensation rate in the first stack receiving the cold air is very high. When used in battery connection the trap capacity is determined for the entire heater as a unit. For heaters installed in two or more tiers, each tier is to be independently equipped with Float and Thermostatic Traps and connections made in similar manner for both tiers. The same applies when two or more groups of heaters are used.

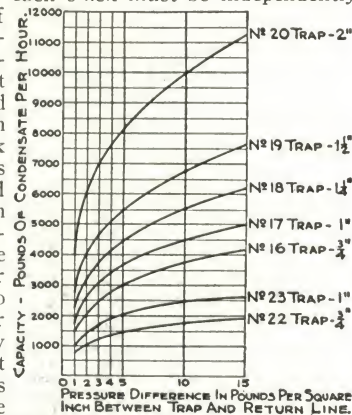


Fig. 947D. Float and Thermostatic Trap Capacities at Various Pressure Differences

To find square feet direct radiation, multiply pounds of condensation per hour by 4

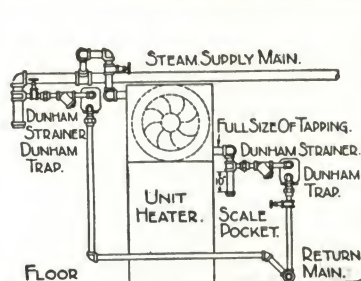


Fig. 982A

Methods of draining a Unit Heating System using Dunham Traps of sizes required

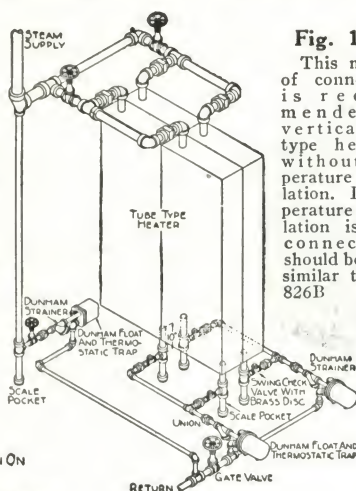


Fig. 1200

This method of connection is recommended for vertical tube type heaters without temperature regulation. If temperature regulation is used connections should be made similar to Fig. 826B

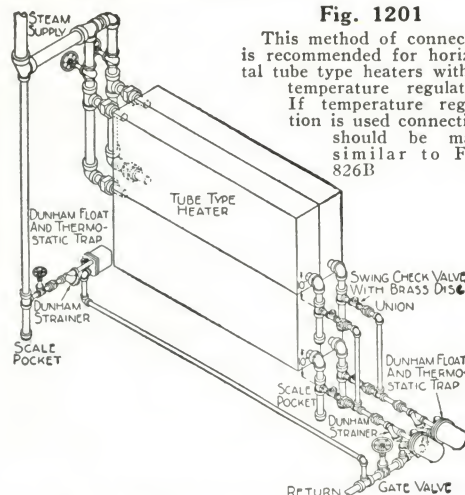


Fig. 1201

This method of connection is recommended for horizontal tube type heaters without temperature regulation. If temperature regulation is used connections should be made similar to Fig. 826B

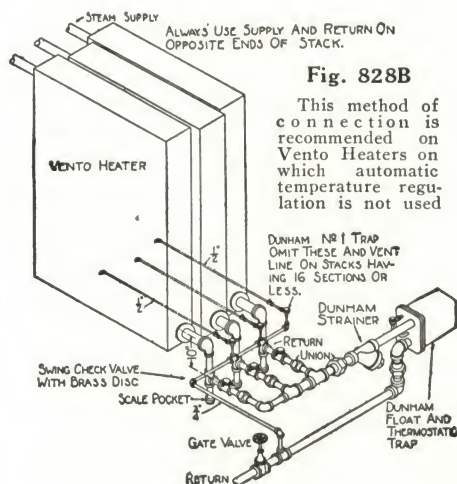


Fig. 828B

This method of connection is recommended on Vento Heaters on which automatic temperature regulation is not used

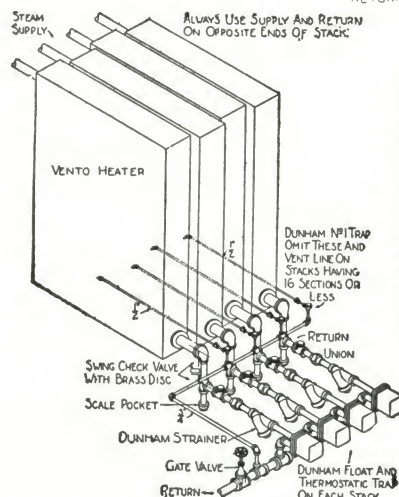


Fig. 826B

This method is recommended on Vento Heaters on which automatic temperature regulation is used. On such installations a hand controlled gate valve should be used on inlet of stack closest to the cold air intake, with no automatic valve on this stack. The gate valve should be left open during freezing weather

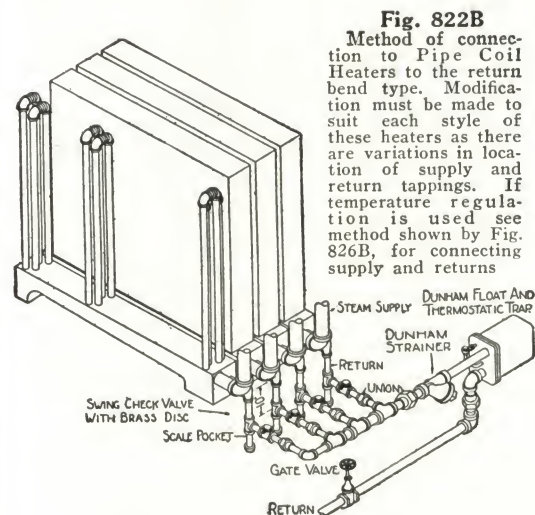


Fig. 822B

Method of connection to Pipe Coil Heaters to the return bend type. Modification must be made to suit each style of these heaters as there are variations in location of supply and return tappings. If temperature regulation is used see method shown by Fig. 826B, for connecting supply and returns

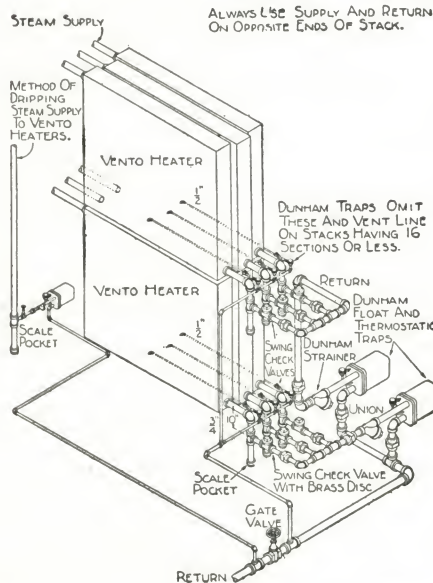


Fig. 1164A

Method shown in Fig. 1164A is recommended on double tiered Vento Heaters. If temperature regulation is used, a gate valve should be used on the inlet of the tier closest to the cold air intake, no automatic valves on this tier. This gate valve should be left open during freezing weather, also the return connection for each tier, to be made as shown in Fig. 826B

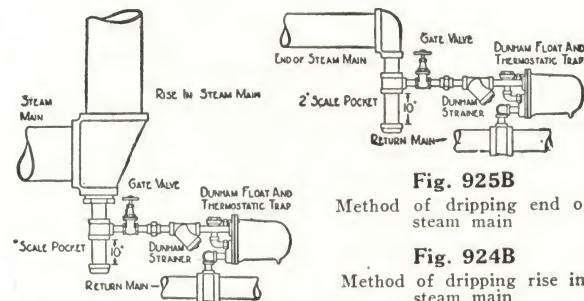


Fig. 925B

Method of dripping end of steam main

Fig. 924B

Method of dripping rise in steam main

Scale Pockets

Figs. 925B and 924B

When a Dunham Trap is used for dripping steam piping it should be installed with at least four feet of connecting pipe between it and the point dripped. A liberal scale pocket should be provided, also a gate valve and strainer in the connection to the trap. Scale pockets should never be smaller than a 2-in. pipe, with 3-in. pipe on large and long mains. Pockets should be 10 in. or more deep, as large space is necessary for collection of dirt.

When used for dripping the end of a steam main, the main should extend not less than 18 in. beyond the last riser connection and be provided with a scale pocket

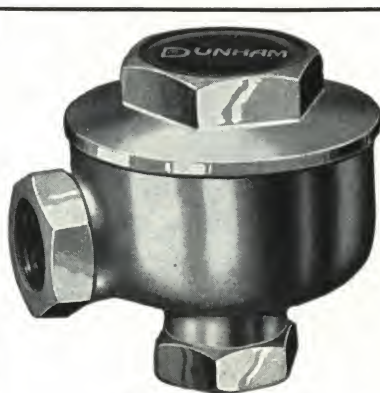
THE DUNHAM MEDIUM PRESSURE TRAP

For Pressures from Zero to 60-lb. Gauge

This Trap is designed for service where pressures are higher than those used in low pressure steam heating. It is the outgrowth of a universal demand for a trap using the Dunham thermostatic principle, which will produce good results in medium pressure service. Its field of usefulness is in connection with hospital steam equipment, kitchen fixtures, laundry equipment, and other similar steam apparatus used in industrial process work.

Description

This trap is made in three sizes: $\frac{1}{2}$ -in., $\frac{3}{4}$ -in. and 1-in., respectively. It is a thermostatic trap made for pressures from zero to 60-lb. gauge, and the temperatures corresponding within those pressure limits. Like a thermometer,



Trap No. 13B

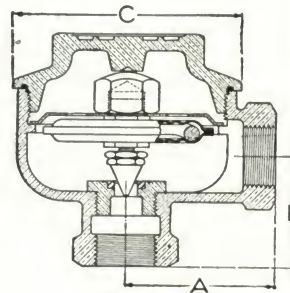


Fig. 1293

Dimension Diagram for 13B, 14B and 15B Medium Pressure Traps

FOR PRESSURES FROM ZERO TO 60-LB. GAUGE

Trap No.	Pipe tapping size, in.	Capacity lbs. water per hr.	Net wt., lb.	Finish	List price	Code	Dimensions inches		
							A	B	C
13B	$\frac{1}{2}$	100	2	Nickel Plated	\$18.00	Irat	2	$1\frac{1}{2}$	$3\frac{1}{16}$
14B	$\frac{3}{4}$	200	6	Painted	27.00	Iren	$2\frac{5}{8}$	$1\frac{5}{8}$	$5\frac{1}{2}$
15B	1	400	$6\frac{1}{4}$	Grey	36.00	Irish	$2\frac{7}{8}$	$1\frac{5}{8}$	$5\frac{1}{2}$

Above list subject to prevailing discounts.

When ordering, state the pressure under which each trap is to operate.

it is suitable for use within the temperature limits for which it is manufactured, and not suitable for use under other conditions.

Construction

The $\frac{1}{2}$ -in. size body and cover is constructed of bronze, the $\frac{3}{4}$ -in. and 1-in. sizes have cast iron bodies and covers. All sizes are fitted with removable valves and seats made of very hard special steam metal, reducing the effect of wire drawing or cutting to a minimum. The reinforced Disc is made of very special phosphor bronze metal formed under pressure. It contains a volatile fluid hermetically sealed within. These traps are non-adjustable. They are tested and adjusted at the factory. The position of the disc in the cover must not be readjusted.

Hotel Kitchens and Restaurants

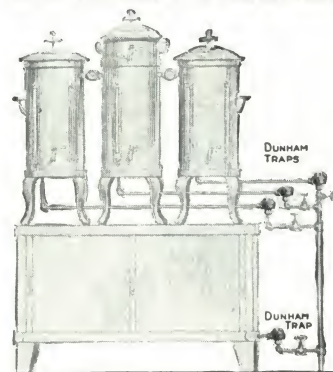
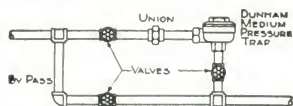


Fig. 833A

This trap is especially well adapted for dripping coffee urns, plate warmers, steam tables, soup kettles and other similar fixtures where medium pressure steam is used.



Hospital Fixtures

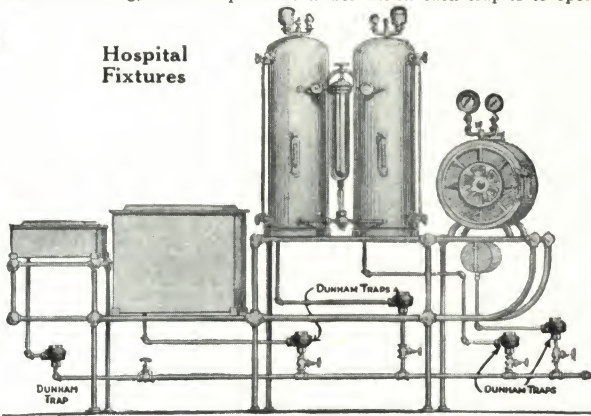


Fig. 834A

When used on hospital fixtures for the operating room, such as sterilizers and distilling apparatus, or in diet kitchens on the steam table, plate warmer, coffee and hot water urns, etc., a saving in the quantity of steam used can be effected since no steam will be wasted into the return line, and the fixtures will be effectively heated.

Fig. 836A

Sometimes it is advisable, when dripping medium pressure steam lines, to install the trap with by-pass as shown.

Kettles

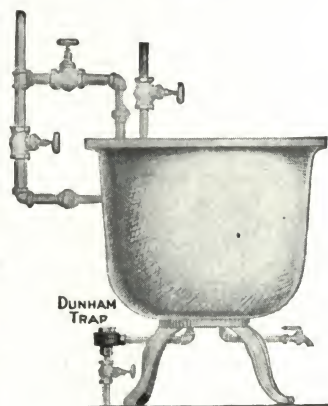


Fig. 835A

As used on an open jacketed steam kettle—candy, soup, or similar cooker.

Process Work—Both Quality and Quantity May Be Increased by the Use of Dunham Traps

In many industrial processes, steam is the heat carrying medium. The product being heated or processed is brought into contact with a metal wall, the other side of which is in contact with the steam. In such cases the heat is transmitted principally by conduction. At the surface of the metal wall through which the heat flows there is a film of indefinite thickness. This film offers considerable resistance to the transmission of heat, which may be measured by the temperature difference between the exterior edge of the fluid film, as t_1 and t_2 in Fig. 974. The amount of heat flowing through a unit of the heating surface depends greatly on the character of the film surface. Where the film is a hot gas the resistance is very high and a large portion of the available temperature difference is required to force the heat flow through the film. If the fluid film is liquid, as of condensing steam, the resistance to heat flow is relatively low and the rate of heat transmission through the surface is very high. See Fig. 975. The Dunham Radiator, Medium Pressure, and Float and Thermostatic Traps release the air from the heating surface, thus permitting the interior surface film to be liquid (such as condensed steam) rather than gaseous (such as air), with consequent high rate of heat flow. As a result of the maximum heat head being available at the surface of the metal, high efficiency of the equipment is obtained.

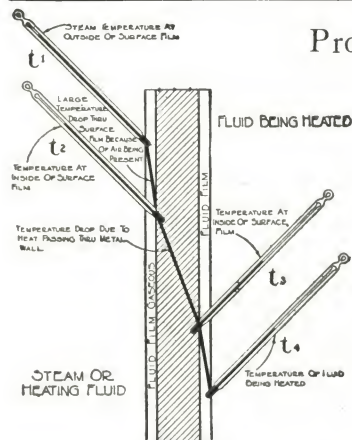


Fig. 974

Temperature gradient with air film on heating medium side. Shows loss of heat head due to presence of air.

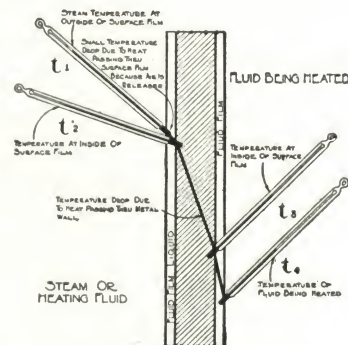


Fig. 975

Temperature gradient with no air film on heating medium side. Shows no loss in heat head on account of presence of air.

THE DUNHAM AIR LINE VALVE

For Pressures Not Exceeding 15-lb. Gauge

The air line valve is an automatic air valve for use on radiators but only in connection with air line piping into which it must discharge. It is positive in action, opening for the

passage of air, closing against the passage of steam. It is non-adjustable. Its principle of operation is identical with the Dunham Radiator Trap. It is neat in appearance. It is particularly applicable where an automatic valve that cannot be easily tampered with is desired. It cannot discharge the bad smelling radiator air into the room, or blow steam on the wall paper, or leak water on the floor.



Fig. 843A. Sectional Drawing Showing Main Parts

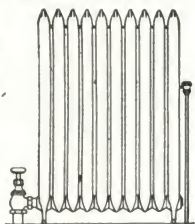


Fig. 845. Method of Attaching to Radiator on Air Line System

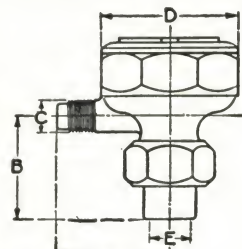


Fig. 846A. Dimension Diagram

DIMENSIONS IN INCHES

Size	Net wt.	List	Code	A	B	C	D	E
$\frac{1}{8} \times \frac{1}{4}$	8 oz.	\$4.00	Turkey	$1\frac{1}{2}$ in.	$1\frac{1}{8}$ in.	$\frac{1}{8}$ in.*	$1\frac{3}{4}$ in.	$\frac{1}{4}$ in.**
$\frac{1}{4} \times \frac{1}{4}$	10 oz.	4.00	Tokio	$1\frac{1}{2}$ in.	$1\frac{1}{8}$ in.	$\frac{1}{4}$ in.*	$1\frac{3}{4}$ in.	$\frac{1}{4}$ in.**

*Pipe Thread. **Pipe Tap.

These valves are furnished rough body, nickel-plated with union nut and nipple. The $\frac{1}{8} \times \frac{1}{4}$ size will be supplied on all orders unless otherwise stipulated.

Special length of union nipples can be supplied, where required to replace other makes of air line valves. Estimates furnished on receipt of particulars.



Type 222

THE DUNHAM AIR CHECK

$\frac{3}{8}$ -in. Pipe Thread

The Dunham air check is applied in the vent opening of Air Eliminator Type 220B on Return and Home Heating Systems. (See pages 31 and 33.) It releases the air at the slightest pressure, but prevents its re-entrance into the system under a receding fire.

Made also for venting accumulator tanks on Dunham Vacuum Return Line Systems and Dunham Differential Vacuum Heating Systems. See pages 18, 53 and 54.

List price—\$2.00 subject to prevailing discount.

Code—Vascheck.

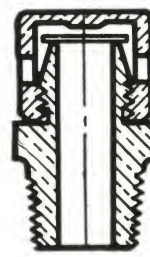


Fig. 981

THE DUNHAM AIR ELIMINATOR

Type 220B for Dunham Home Heating and Return Heating Systems

Used to vent the air from the return piping in the Dunham Home Heating and Return Heating Systems. It prevents water from escaping. It is always open to atmosphere except

when pressure on the boiler causes the water to close the mechanism.

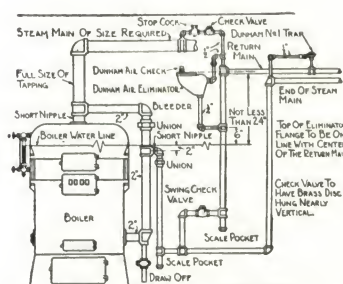


Fig. 860D. Method of Installing Eliminator Type 220B on Installations Using Boiler with One Supply Tapping

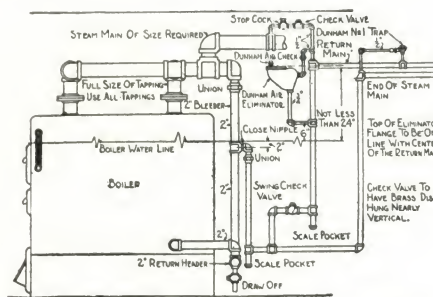


Fig. 937C. Method of Installing Eliminator Type 220B on Installations Using Boiler with Two or More Supply Tappings

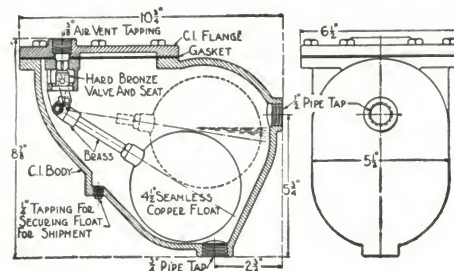


Fig. 1205

Type No.	Tappings, in.			Cap. sq. ft. direct rad.	List price	Net wt., lb.	Code
	Bot- tom	Side	Air vent (top)				
220B	$\frac{3}{4}$	$\frac{1}{2}$	$\frac{3}{4}$	2,000	\$30.00	21 $\frac{3}{4}$	Vasold

Includes Dunham Air Check (Type 222) above to be placed in $\frac{3}{8}$ -in. vent tapping.

Type 221A for Vapor Installations Having More Than 2,000 Sq. Ft. Direct Radiation

It is open to atmosphere except when pressure on boiler causes the float to rise thus closing the air vent. The detail,

Fig. 938A, illustrates typical method of installing this eliminator.

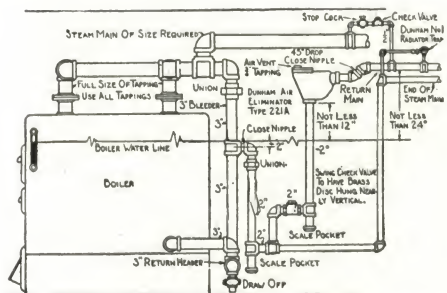


Fig. 938A. Method of Installing Eliminator Type 221A



Type 221A

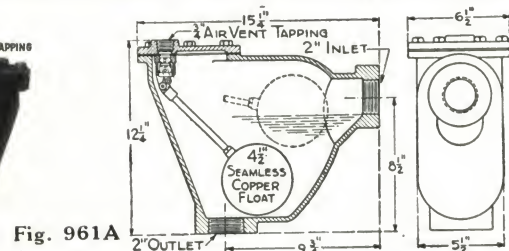


Fig. 961A

Type No.	Tappings, in.			Cap. sq. ft. direct rad.	List price	Net wt., lb.	Code
	In- let	Out- let	Air vent				
221A	2	2	$\frac{3}{4}$	6,000	\$42.00	33	Vascomb

CHECK VALVES FOR HEATING SYSTEMS

Most check valves on the market have been especially designed for high pressure service, and the main consideration in connection with the design of the disc was that it should withstand the high forces to which it would be subjected. Check valves for application to a steam heating system must be selected from among those which are least objectionable from the standpoint of design, operation and service.

Check valves of type shown in Figs. 941 and 942 offer the least resistance to minimum flow, and will give satisfactory service on heating installations.

Check valves should have both the lugs and hinge pin (A) on disc holder, and the groove in which they rest, properly machined, so the disc (B) is free to move without the tendency to "hang-up."

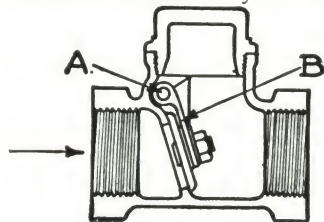


Fig. 941

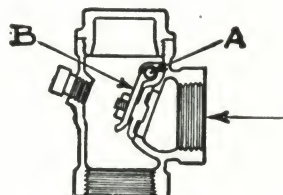


Fig. 942

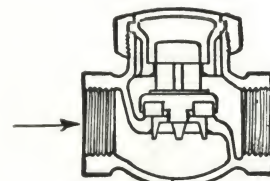


Fig. 943

DUNHAM LIFT FITTINGS

It is of course best practice to design a Vacuum Return Line Heating System without lifts or pick-ups, but sometimes the fitter is confronted

main rises and drips on the ordinary low pressure vacuum return line system because on these installations the system is allowed to cool down completely during mild days, and



Type 780

with a job where the returns cannot be brought to the vacuum pump in any other way. Type 780 is scientifically designed and will eliminate guess work as to design and uncertainty of operation.

These fittings however must never be used on a Differential Vacuum Heating System. They must not

be used on a vacuum return line system where steam pressure will not be maintained continuously on the heating mains throughout the entire heating season. They therefore must not be used on the end of steam mains, or where the

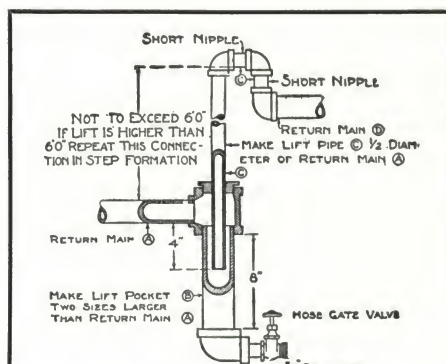


Fig. 879. Showing How Lift Connection in Vacuum Return Main Larger Than 2-in. May Be Built of Pipe and Fittings

water hammer might develop when the system is fired up, before sufficient differential in pressure has been created so as to lift the water out of the steam main.

In most cases by giving careful study to the run of piping the system can be so designed that the apparent need of a lift fitting will disappear. Avoid lift connections in return main, except right at the vacuum pump, and if needed at this point, arrange it so that all the returns pass through the lift connection.

If it becomes necessary to use lift connections in overcoming obstacles the Dunham Lift Fitting will simplify the connection and eliminate mistakes often made in assembling such connections from standard pipe and fittings.

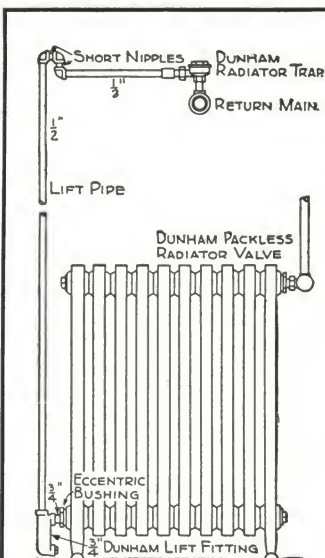


Fig. 958A

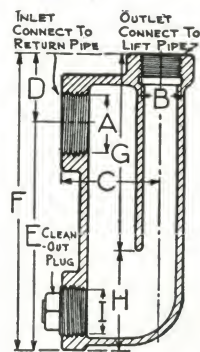


Fig. 954

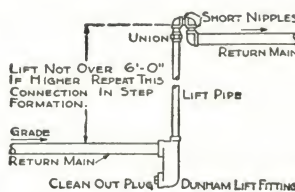


Fig. 957A. Lift Connection for the Return Main of Vacuum Return Line System Located Lower Than Pump Inlet

SPECIFICATIONS AND LIST PRICES OF LIFT FITTINGS

Type	Size, in.	Net wt., lb.	Roughing in dimensions in inches									List price	Code
			A	B	C	D	E	F	G	H	I		
780	3/4	2 1/2	3/4	1 1/2	1 3/4	1 3/8	4 3/4	6 1/8	3 3/4	2 3/8	3/4	\$2.40	Litang
781	1	3	1	2	2 1/4	1 1/2	5 1/4	6 3/4	4 3/8	2 3/8	1	2.80	Litang
782	1 1/4	4	1 1/4	2 3/4	2 3/8	1 3/4	6 1/4	7 3/4	5 1/8	2 3/4	1	3.60	Litang
783	1 1/2	5 1/2	1 1/2	3	2 3/4	2	6 3/8	8 3/8	5 3/8	3	1	4.40	Litang
784	2	8	2	4	3 3/8	2 1/4	7 1/2	9 3/4	6 3/4	3	1	5.60	Litang

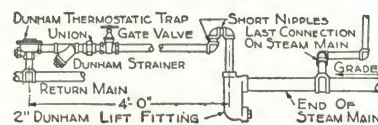


Fig. 955A. Drip Connection Using Thermostatic Trap for Draining a Small Steam Main with Drip Point Below Return. Applies to Vacuum Return Line Systems Only

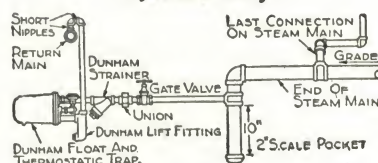
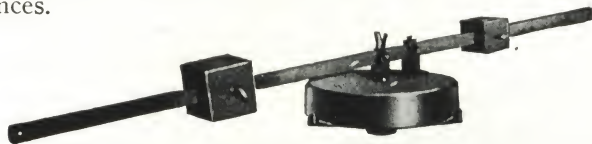


Fig. 956A. Drip Connection Using Float and Thermostatic Trap for Draining Steam Main with Drip Point Below Return. Applies to Vacuum Return Line Systems Only

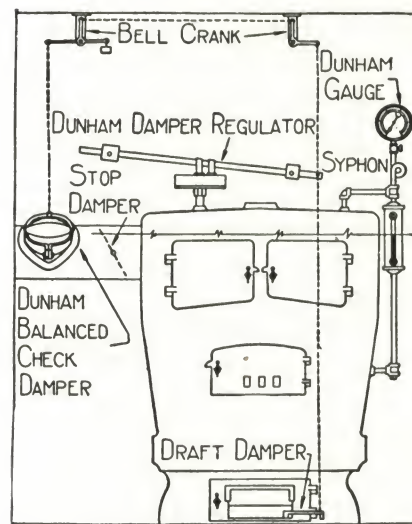
DUNHAM DAMPER REGULATOR

Types 350 and 351

The Diaphragm Damper Regulator is furnished in two sizes, and is made with a large diameter all metal diaphragm, sensitive for the regulation of pressure in ounces.



Type	Diam., in.	Length of arm, in.	Shipping weight boxed, lb.	Connection, in.	List	Code
350	7	48	30	1	\$20.00	Vasing
351	10	48	45	1	27.00	Vasamp



The Type No. 350 7-in. Regulator is for use on the Dunham Return System and is supplied with pulleys. Type No. 351 10-in. Regulator is for use on the Dunham Home Heating System and is supplied with bell cranks as illustrated.

Fig. 859A. Method of Installing Dunham Damper Regulator, Dunham Check Damper to Be Placed at 45° Angle on Smoke Pipe

The pressure within the boiler acts directly on the large diaphragm, causing it to expand or contract as the pressure increases or decreases, and draft and check dampers are closed or opened as required.

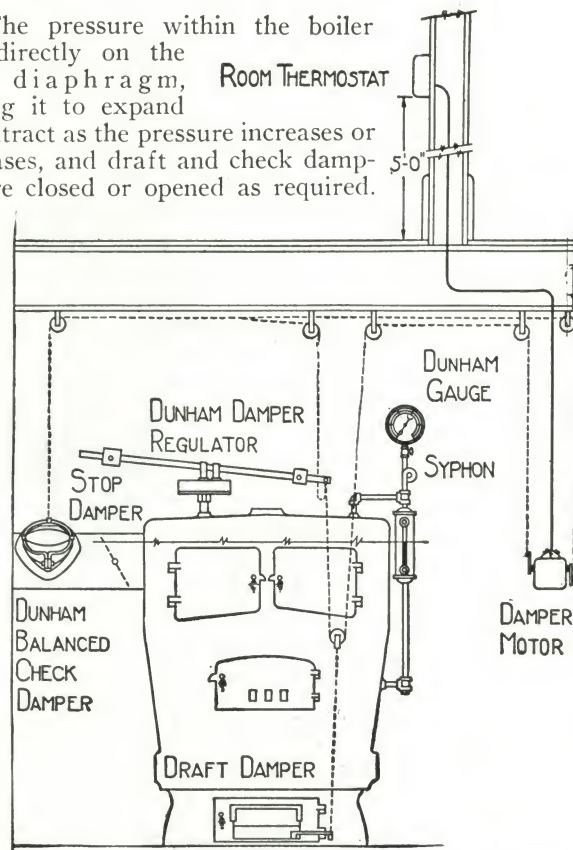


Fig. 1154. Typical Method of Installing Dunham Damper Regulator and Dunham Check Damper in Conjunction with an Electric Damper Motor Operated by a Room Thermostat



Type 340. Balanced Check Damper Complete

THE DUNHAM BALANCED CHECK DAMPER

This Check Damper is designed with a large opening so that the fire may be checked quickly when the damper is operated, a very important feature for steam heating systems operating on low pressures. It should be installed at an angle of 45° on the horizontal smoke pipe, see Fig. 859A and Fig. 1154.



Saddle



Damper and Ring

Type	Description	Ship. wt., lb.	List price	Code
340	9 in. Damper and Ring and 9 in. Saddle*	22	\$7.20	Vasupe
341	9 in. Damper and Ring and 10 in. Saddle*	22	7.20	Vasapa
342	9 in. Damper and Ring and 11 in. Saddle*	22	7.60	Vasipi
343	12 in. Damper and Ring and 12 in. Saddle*	30	9.20	Vasoon
345	12 in. Damper and Ring and 14 in. Saddle*	30	9.60	Vasbin
346	12 in. Damper and Ring and 15 in. Saddle*	30	9.60	Vasblu
347	12 in. Damper and Ring and 16 in. Saddle*	30	10.40	Vascot
348	9 in. Damper and Ring only	6½†	4.80	Vasara
349	12 in. Damper and Ring only	15†	5.60	Vasord

*Size of Saddle indicates diameter of smoke pipe it will fit.

†Net weight.

When the smoke pipe is larger than 16 in., the customer must supply a steel saddle, as a part of the smoke pipe, made to fit Check Damper and Ring supplied.

DUNHAM TEMPORARY CAPS

A Temporary Cap is a Trap Cover without the thermostatic disc. These caps permit steam to blow into return to waste, thereby blowing out or cleaning the entire system. They are loaned to the heating contractor and used as a method for clean-out purposes. The permanent cap and disc is removed from the trap body and replaced by a temporary cap which remains there until the entire system has been thoroughly cleaned, when it is removed, the bodies wiped



Fig. 900 Temporary Cap

out with a cloth and the permanent cap and disc put back.

Code—Nos. 1A, D1, Capo; Nos. 2B, D2, Capot; Nos. 3A, D3, Capom; Nos. 4A, D4, Capor; Nos. 5A, D5, Capov.

Temporary Caps when supplied to the customer for temporary use will be billed at \$1.00 each net. Credit of \$1.00 each net will be issued upon receipt of the cap at our factory in good condition.

Customer to pay transportation charges each way.

THE DUNHAM RETURN TRAP

For Pressures Not Exceeding 15-lb. Gauge

This trap is designed especially for low pressure heating service. It is self-contained and positive in action, having large connections for its capacity and liberal valve areas. It is operated by the raising and lowering of the water which accumulates in and is discharged from the trap. The air port valve remains wide open as the trap is filling and is closed when boiler steam pressure is admitted and the trap is discharging. All its working parts are protected from dust and dirt yet are accessible without removing any piping. Its function is to separate the air and water discharged into the dry return piping by the Dunham Radiator Traps, to release the air, and to return the water to the boiler regardless of the pressure carried in boiler or system within the limit of 15-lb. gauge.

Operation

As boiler pressure increases above the point at which condensate will not return to the boiler by gravity, it collects in the body of the trap, lifting the float as the waterline in the trap rises.

Float arm engages with large weight bracket, moving it upward. As large weight moves past center it falls, tripping small weight which closes vent valve. Large weight continues its arc, opening steam valve admitting boiler pressure into trap causing condensate in trap to flow to boiler. The float lowers with the waterline in the trap thus bringing the weights to their original position, closing steam valve and opening vent valve.

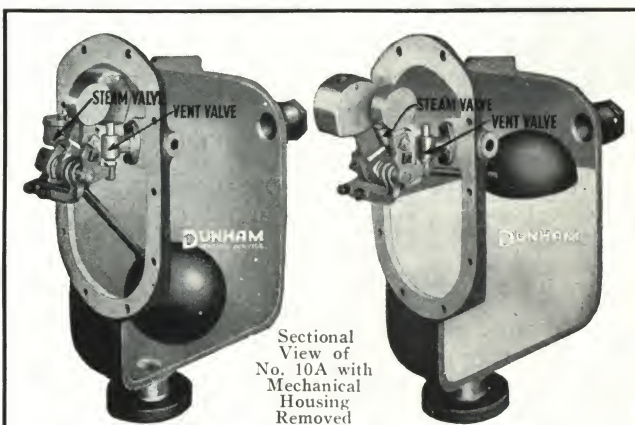


Fig. 933A. Return Trap Ready to Fill

Steam valve closed, vent valve open

Fig. 934A. Return Trap Ready to Discharge Condensate to Boiler

Steam valve open, vent valve closed

Installation

The trap must be installed near the boiler in a level and plumb position with its bottom as high above the boiler waterline as possible.

The capacities are based upon the trap being installed with its bottom at a minimum height of not less than 6 in. above the normal boiler waterline. The piping connections are to be made as shown in the installation illustrations in Dunham Data under Return Heating system (Dunham Pages 31 and 32), using check valves of the horizontal swing type with light weight brass disc.

SIZES AND CAPACITIES DUNHAM RETURN TRAPS

These capacities are standard when distance between boiler waterline and bottom of trap is as given. It is possible to increase the capacity with increase in height of trap above waterline.

Return trap Size No.	Distance between boiler water line and bottom trap in inches	Rated capacities sq. ft. direct radiation
9A	6	3000
9A	10	3400
9A	18	3600
9A	24	3800
9A	36	4000
10A	6	5000
10A	10	5400
10A	18	5600
10A	24	5800
10A	36	6000
11A	6	8000
11A	10	8500
11A	18	9000
11A	24	9500
11A	36	10000
12A	6	13000
12A	10	17000
12A	18	18000
12A	24	19000
12A	36	20000

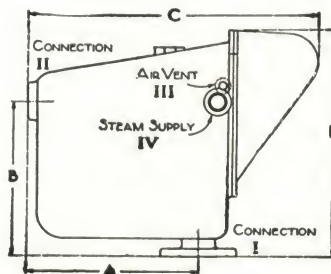


Fig. 863A. For Pressures Not Exceeding 15-lb. Gauge

Note: Prices include Air Eliminator, also Companion Flanges, Bolts, Gaskets, on traps Nos. 10A, 11A, and 12A. Trap 9A has screwed connections, traps Nos. 10A, 11A and 12A have flanged bottom connection. I. Air check is included in price of 9A.

Size No.	Ship. wt., lb.	Conn. sizes. in.				Dimensions, in.					List price	Code
		I	II	III	IV	A	B	C	D	Width overall		
9A	120	2	1 1/2	1 1/2	1	11 1/4	13 3/8	22 3/8	20	9	\$90.00	Renine
10A	155	3	2	1 1/2	1	12 3/4	14 1/2	24 1/4	21 1/4	9 3/8	150.00	Reten
11A	220	3	2 1/2	3/4	1 1/2	16	14 1/2	27 3/8	21 1/4	13	200.00	Releven
12A	400	4	3	3/4	2	23	14 1/2	34 1/2	21 1/4	19	300.00	Rewely

3/4 in. Gauge Glass Set furnished on special order only. \$6.00 list, in which case return trap is tapped for gauge glass at no extra charge. Return traps are furnished with connections as listed in Dimension Table. However trap 9A is equipped with 1 1/2 in. bushing and traps 10A, 11A and 12A with reducing flanges making connections 2 in., 2 1/2 in. and 3 in. respectively. Connection II on Trap 9A plugged. Traps 10A, 11A and 12A furnished bushed to 3/4 in.

Gauges for Pressures to 200 Lb. and Vacuum to 30-in.

Furnished with steel case, nickelplated ring, silvered dial, male connection, threaded 1/4 in. Figures and graduations on pressure side of dial are shown in black, on vacuum side in red.

Size, in.	Type 520 30 lb. steam		Type 530 200 lb.		Type 540 30 in. vacuum	
	List price	Code	List price	Code	List price	Code
5	\$ 8.20	Gamedfi	\$ 8.20	Gahifi	\$ 8.20	Gavafi
6	13.50	Gamedox	13.50	Gahix	13.50	Gavax
8	22.75	Gamedat	22.75	Gahiat	22.75	Gavaat

Size, in.	Type 550 30 in. vacuum 15 lb. pressure		Type 560 30 in. vacuum 30 lb. pressure	
	List price	Code	List price	Code
5	\$14.25	Gacofi	\$14.25	Gatefi
6	16.50	Gacox	16.50	Gateox
8	30.75	Gacoat	30.75	Gateat

The above prices are for gauges separate from boards.

Low Pressure Gauge

Furnished with black enameled steel case, nickelplated ring and silvered dial, male connections threaded 1/4 in.



Type 551

Size	Type	List price	Code
5 in.	551	\$12.00	Galovan

This Dunham compound gauge registering 10-lb. pressure and 20-in. vacuum is graduated in 1/2 lb. divisions on the pressure side of gauge. Figures and graduations on pressure side of dial are shown in black, on vacuum side in red. This gauge is specially designed for the Dunham Home Heating System.

Syphon and Cock

Iron pipe syphon (1/4 in.) and brass gauge cock are not included in above prices but will be furnished for \$2.00 list. Code word "Sygaco." Install syphon or its equivalent under any steam gauge so that only water can enter the tube.

DUNHAM PRESSURE REDUCING VALVES

For Reduced Gauge Pressure of 10 Lb. Where Initial Pressure Is from 125 to 40 Lb.

Application—This valve is so designed that pressure does not build up on the low side even with a considerable variation on the high pressure side, except on dead end service when this type of valve is not recommended. Where the initial pressure is greater than 125 lb. it is advisable to first reduce to a medium pressure.

Construction—The body, yoke and diaphragm casing are soft grey iron (except in ¼-in. size in which the body is made of bronze) the balanced valve and seats are a special bronze steam metal; the diaphragm is special para rubber reinforced with heavy weight fabric; the stuffing box, nut, gland, and valve stem are phosphor bronze. In the design and in the selection of its material a reliable and durable device is supplied for the service it must perform.

Sizes and Prices—The Reducing Valves are made in both straight and expanded outlet patterns. In all regular expanded outlet patterns the diameter of the outlet is standardized at twice the diameter of the inlet. An outlet of other diameter as listed is special

and not carried in stock, but can be supplied on short delivery.

Installation—Install the reducing valve in a horizontal steam main as shown in Figs. 854 and 1178. The ½-in. pressure balancing pipe from low pressure main to bottom of diaphragm casing, should be connected into the side or top of the low pressure main at a distance not less than 20 ft. from the reducing valve. A globe valve must be installed in this pipe. **Precaution:** It is good practice to install a 2-in. pop safety valve on the low pressure heating main, a few feet away from the reducing valve, as a safeguard against inadvertent handling. The pop safety valve to blow at 15 lb. pressure.

Sizing Pressure Reducing Valves—

The Reducing Valve Chart (Fig. 1199A) has been prepared to guide in the choice of the proper size reducing valve for heating installations. With heating service in mind, the curves have been put in terms of square feet of equivalent radiation, initial pressure, and final or service pressure. Knowing these three factors the correct valve size may be read directly.

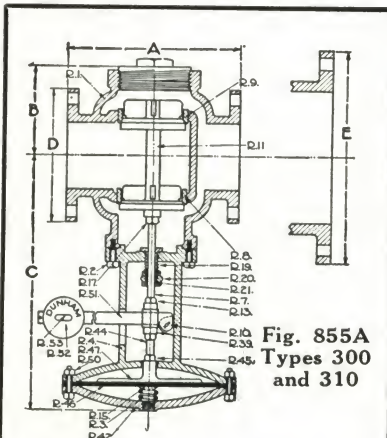


Fig. 855A
Types 300
and 310

SIZES, WEIGHTS AND PRICES OF TYPE 300 (STRAIGHT PATTERN) AND TYPE 310 (EXPANDED OUTLET) PRESSURE REDUCING VALVES

List prices are subject to prevailing discounts. Prices do not include companion flanges or bolts.

When ordering, the initial and reduced pressures for which each valve is to be used must be given together with the amount of steam the valve is to supply in square feet of equivalent direct radiation or in pounds of steam per hour.

Straight Pattern Type 300

Regular Sizes Carried in Stock	Size	Connection	Wght., lb. boxed	List price	Code	Dimensions in inches (See Fig. 855A)			
						A	B	C	D
1	¾	Screwed	37	\$44.00	Antelope	4 1/8	2 3/4	12	...
1 1/4	1 1/4	Screwed	41	48.00	Anthem	4 7/8	4	15 5/8	...
1 1/2	1 1/2	Screwed	110	50.00	Antic	6 3/8	4	15 5/8	...
2	2	Screwed	128	54.00	Antidote	7	4 3/8	16 1/8	...
2 1/2	2 1/2	Flanged	139	60.00	Antipathy	8 3/8	5 3/8	16 3/8	6
3	3	Flanged	166	74.00	Antipode	9	6	17	7
3 1/2	3 1/2	Flanged	186	88.00	Antler	11 3/8	6 1/8	18 1/8	7 1/2
4	4	Flanged	200	96.00	Aonian	11 1/4	7 1/8	17 1/2	8 1/2
5	5	Flanged	251	106.00	Aorta	14	7 1/8	19 1/8	9
6	6	Flanged	312	130.00	Ape	15 1/4	8 3/8	20 3/8	10
8	8	Flanged	435	160.00	Apostle	17 3/8	9	21 1/8	11
			606	248.00	Apparel	19	12 1/8	24 1/8	13 1/2

Expanded Outlet Pattern Type 310

Regular Sizes Carried in Stock	Size	Connection	Wght., lb. boxed	List price	Code	Dimensions in inches				
						A	B	C	D	E
1 1/2 x 3	1 1/2 x 3	Screwed	130	\$64.00	Shire	7 3/8	4 3/8	16 1/4	...	...
2 x 3	2 x 3	Screwed	149	76.00	Stag	8 1/2	5 3/8	16 3/4	...	...
2 x 4	2 x 4	Flanged	160	76.00	Sirrah	9	5 3/8	16 3/4	6	9
2 1/2 x 5	2 1/2 x 5	Flanged	170	90.00	Sliver	9 1/4	5 3/8	17	7	10
3 x 6	3 x 6	Flanged	200	106.00	Slotch	11 1/4	6 3/4	17 3/4	7 1/2	11
4 x 6	4 x 6	Flanged	234	144.00	Stanza	12 1/2	6 3/8	18 3/4	9	11
4 x 8	4 x 8	Flanged	251	146.00	Sooth	12 3/4	6 3/8	18 3/4	9	13 1/2

Special Sizes Not Carried in Stock	Size	Connection	Wght., lb. boxed	List price	Code	Dimensions in inches				
						A	B	C	D	E
1 1/2 x 2	1 1/2 x 2	Screwed	129	\$64.00	Squab	7 1/8	4 3/8	16 1/4	...	...
1 1/2 x 2 1/2	1 1/2 x 2 1/2	Screwed	132	64.00	Squall	7 1/4	4 3/8	16 1/4	...	...
2 x 2 1/2	2 x 2 1/2	Screwed	144	76.00	Stable	8 1/2	5 3/8	16 3/4	...	...
2 x 3 1/2	2 x 3 1/2	Screwed	152	76.00	Stalk	8 3/8	5 3/8	16 3/4	...	...
2 x 3 1/2	2 x 3 1/2	Flanged	157	76.00	Squawk	8 3/8	5 3/8	16 3/4	6	8 1/2
2 x 4	2 x 4	Screwed	154	76.00	Stalker	9	5 3/8	16 3/4	...	...
2 1/2 x 4	2 1/2 x 4	Flanged	168	90.00	Staves	10	5 3/8	17	7	9
3 x 5	3 x 5	Flanged	191	106.00	Steenbok	11 1/4	6 3/4	17 3/4	7 1/2	10
4 x 5	4 x 5	Flanged	223	144.00	Sough	12 1/2	6 3/8	18 3/4	9	10
5 x 8	5 x 8	Flanged	298	174.00	Starch	13 1/2	7 3/8	19 3/4	10	13 1/2
5 x 10	5 x 10	Flanged	325	176.00	Slue	14 1/8	7 3/8	19 3/4	10	16
6 x 12	6 x 12	Flanged	438	218.00	Steak	14 3/4	8 3/4	20 3/8	11	19

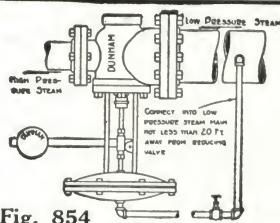


Fig. 854

Fig 854. Typical Connection for a Single Reducing Pressure Valve Installation

If by-pass is required, install this as recommended in Fig. 1178

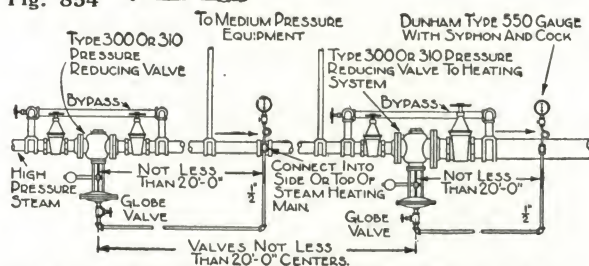


Fig. 1178. Typical Method of Installing Pressure Reducing Valves on an Installation on Which High Pressure Is Reduced to Low Heating Pressure in Two Steps

The medium pressure, in this case, servicing laundry and cooking equipment. A medium pressure of 50 to 60 lb. is ample for this purpose.

The by-pass should be made two sizes smaller in size than the high pressure side of the reducing valve. For example: a 4x6-in. valve requires a 3-in. by-pass. The by-pass is used when the reducing valve is out of service. The gate valve in the by-pass is often used for throttling the steam flow until the required reduced pressure is obtained on the gauge. Install a 2-in. pop safety valve on heating system main, as a safeguard against letting full head of steam into system. The pop valve set to blow at 15 lb. pressure

Chart for Sizing Pressure Reducing Valves

Follow the diagonal dash-line corresponding to the sq. ft. of equivalent cast iron radiation to its intersection with the heavy horizontal line corresponding to the final or service pressure. Go vertically up or down from this intersection to the horizontal line corresponding to the initial or boiler pressure. The nearest solid diagonal line gives the size of the reducing valve that should be used, that is, the nominal inlet diameter.

The following example clearly shows the simplicity of application to sizing problems. Example: A building to be heated with steam at 5 lb. gauge pressure, with a boiler pressure of 75 lb. The equivalent cast iron radiation is 48,000 square feet. What size pressure reducing valve is needed?

Solution: On the bottom scale of chart the point representing 48,000 sq. ft. radiation is found at "A." Following the diagonal dash-line to the intersection with the heavy horizontal line representing 5 lb. service pressure brings us to point "B." On the line representing an initial pressure of 75 lb. vertically above point "B" we arrive at point "C." Point "C" lies very close to the heavy diagonal line representing a 4-in. pipe size, hence a Dunham Pressure Reducing Valve with 4-in. inlet diameter would be used and if a standard expanded outlet pattern valve could not be obtained on account of size of heating main, a straight pattern valve would be used and a reducer specified for the low pressure side of the reducing valve to increase the outlet side to the size of the low pressure main.

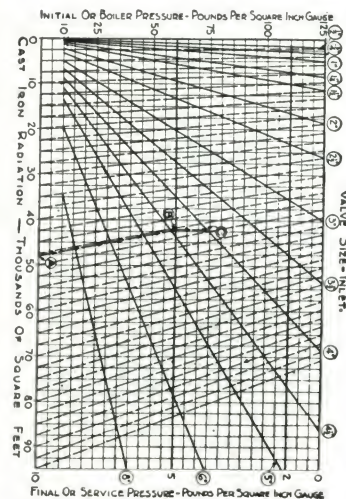


Fig. 1199A. Chart for Sizing Pressure Reducing Valves

DUNHAM VACUUM PUMP GOVERNOR

The function of this vacuum pump governor is to regulate the speed of a steam driven vacuum pump to maintain a fixed partial vacuum condition in the return piping of a Vacuum Return Line Heating System, in which a definite condition of vacuum is required.

The governor is made of the highest grade materials, similar to

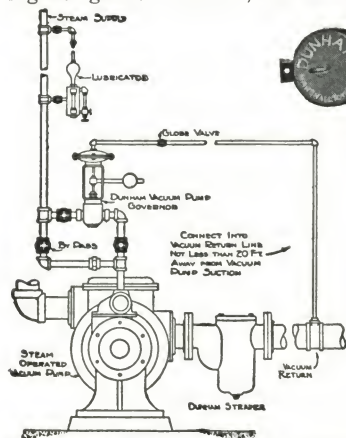
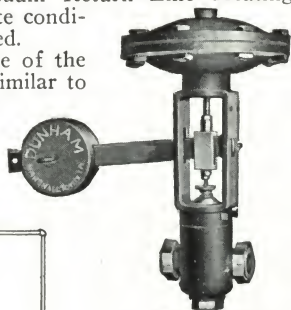


Fig. 856B. Typical Connection for Vacuum Pump Governor



Type 320

Screwed connection size	Body style	Wt. lb. boxed	Dimensions in inches (See fig. 857B on this page)			List price	Code
			A	B	C		
1/2	Bronze	37	4 1/4	2 3/8	11 7/8	\$46.00	Spern
3/4	Bronze	40	4 3/4	2 3/8	11 7/8	48.00	Spew
1	Cast Iron	70	5 3/8	4	15 3/8	52.00	Spium
1 1/4	Cast Iron	78	6 3/8	4	15 3/8	54.00	Spider
1 1/2	Cast Iron	90	7	4 3/8	16 3/4	60.00	Spier
2	Cast Iron	100	8	5 1/2	17	66.00	Spine

those used in the Dunham Pressure Reducing Valve. It is sensitive yet durable and can be depended upon with a minimum amount of attention.

Installation

It should always be installed in a horizontal line of piping, plumb and true. A typical installation is illustrated in Fig. 856B on this page. It should be noted that the balancing pipe, which is the pipe connecting the top diaphragm casing of the governor with the vacuum return line, should be connected not less than 20 ft. away from the governor. The balancing pipe to be 1/2-in. pipe. A globe valve must be placed in this pipe.

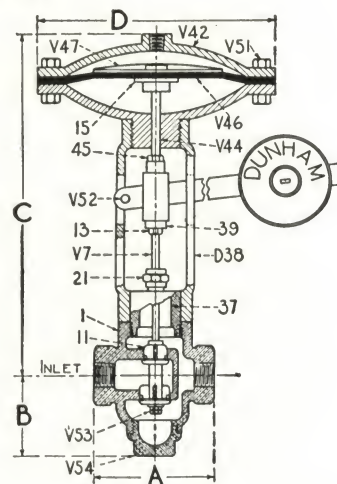
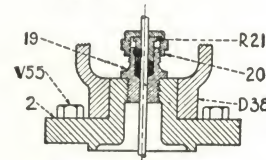


Fig. 857B



BONNET AND STUFFING BOX GOVERNORS 1" AND LARGER

Fig. 858B

The Dunham Strainer is simple in design, of liberal area and free from an internal water seal. There is a free passage to the vacuum pump, or point of release.

Construction

This strainer is built of the best soft gray iron casting, heavy and durable, with easily removable cover and sediment basket. The strainer basket is of 22 gauge brass sheet having .079-in. diameter holes, 81 holes to the square inch. The basket for Type 210A has a cast base and top rim. When in position in the strainer the top rim of the basket rests upon a flange in the body casting, so that the flow is into the basket which catches and holds all scale, sediment, or other foreign matter while the water passes through the perforations and out.

In Type 211 the basket is inserted from the bottom and held in position by recesses in the body casting and plug, performing the same function as Type 210A.

In both types the basket can be easily removed for cleaning.

Location

Strainers are recommended at the drip traps, thus preventing these from being clogged with dirt, chips, etc., from the radiation and steam piping. See Fig. 925B.

Another use for a strainer is in the return main before connecting the return trap.

A strainer installed at the inlet connection of the return trap will prevent trash from the heating system working its way into the check valves, causing them to stick open.

The strainer basket should be removed at frequent intervals and the accumulated sediment removed. This is important during the first heating season during which there usually is much foreign matter to be removed before the system becomes fully efficient.

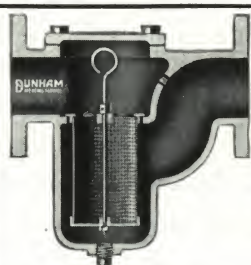


Fig. 850A. Sectional View Type 210A



Type 211. Basket of Type 211

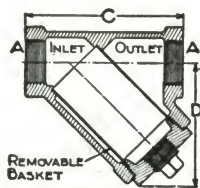


Fig. 891A. Type 211

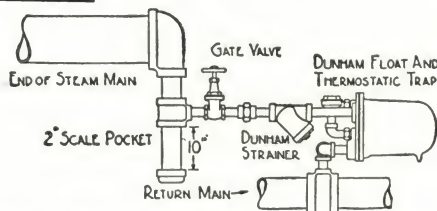


Fig. 925B. Method of Dripping Steam Main Using Strainer in the Connection

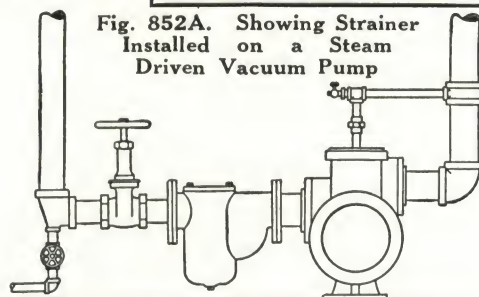


Fig. 852A. Showing Strainer Installed on a Steam Driven Vacuum Pump

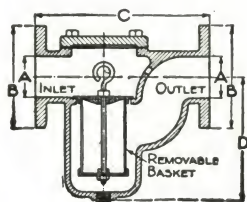


Fig. 853A. Type 210A

SPECIFICATIONS AND PRICE LIST

Type No.	Size tappings, in.	Connection	Net weight, lb.	Roughing-in dimensions, in.					List price complete	Code	For basket only	
				A	B	C	D	Overall width			List price	Code
211	3/4	Screwed	3 1/2	3 3/4		4 1/2	4 1/2	2 3/4	\$4.00	Laugh	\$0.80	Balaugh
211	1	Screwed	3 1/2	1		4 3/4	4 1/2	2 3/4	4.80	Laundress	0.80	Balaund
211	1 1/4	Screwed	5 1/2	1 1/4		5 1/2	5	3 3/4	6.00	Laurel	1.60	Balaurel
211	1 1/2	Screwed	7	1 1/2		6 3/8	5 1/2	4	7.20	Laureate	1.60	Balaureate
211	2	Screwed	7	2		6 3/8	5 1/2	4	9.00	Lavatory	2.40	Balavatory
210A	1 1/2	Flanged	25	1 1/2	5	9 1/2	7	5 1/8	21.60	Lavender	7.20	Balavender
210A	2	Flanged	28	2	6	9 3/4	7	6	26.00	Lavish	8.00	Balavish
210A	2 1/2	Flanged	45	2 1/2	7	12 1/16	9	7	30.00	Leaky	9.00	Baleaky
210A	3	Flanged	50	3	7 1/2	12 1/16	9	7 1/2	34.00	Lemon	11.00	Balemon
210A	4	Flanged	74	4	9	15 1/2	10 3/8	9	52.00	Legion	16.00	Balegion
210A	5	Flanged	105	5	10	17 3/8	13	10	66.00	Lever	20.00	Balever
210A	6	Flanged	125	6	11	20	14 3/4	11	88.00	Lettuce	22.00	Balettuce

THE DUNHAM VACUUM PUMP

The Dunham Vacuum Pump coordinates the results of scientific research and approved engineering practice.

A vacuum pump should be chosen for its ability to handle air, condensable gases and water, the three elements to be removed from the returns of the heating system, not for its ability to handle only one of these elements. Consider then—

1. A Vacuum Pump of itself has no intrinsic value.
2. To determine its merits, it must be considered in relation to the purpose it performs.

3. Its first purpose is to accelerate circulation of steam in the heating system. Whether or not it produces a certain vacuum on cold air, drawn in from the atmosphere through a given size hole or not, is not pertinent. The orifice test is a satisfactory method for measuring air under certain conditions, under other conditions it is not satisfactory. Such a test is not a criterion on which to establish the selection of a vacuum pump.

Capacity is a measure of the ability to obtain and maintain a desired range in vacuum on the return lines of a heating system under operation. One pump may exceed in air capacity, another in water capacity, another in ability to condense vapor from the return lines, but the real test is the ability to handle the load of a heating system with the least expenditure of power.

Experience has shown that the volume of vapor to be handled is much more of a factor than is appreciated. The Dunham Exhauster operates similarly to a barometric jet condenser removing easily this vapor by condensing it. The principle of operation is unique and efficient, for with one moving element we produce a powerful suction by means of the exhauster and maintain a positive pressure to discharge water to the boiler.

Description and Operation

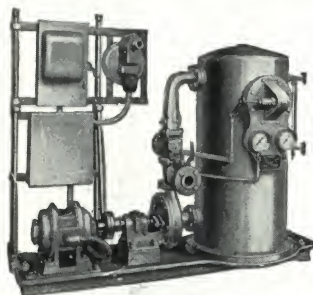
The Dunham Vacuum Pump consists of an electrically driven centrifugal pump, a Dunham Exhauster,

an air separating and receiving tank and an automatic discharge valve, all assembled on a rigid base with the necessary control equipment so as to make a complete compact unit.

The hurling water is stored in the separating and receiving tank from which the centrifugal pump takes its supply, under a constant positive pressure, due to the static head. (See illustration in center Fig. 1214A.) The centrifugal pump delivers water to the exhauster at a steady pressure of 20 lb. per sq. in. The water the pump delivers in flowing through the exhauster nozzles has the pressure energy converted into kinetic energy (energy due to velocity) and is directed into the delivery tubes after it has passed through the suction space in the nozzle body. In passing through the suction space the air vapor mixture and the water of condensation is entrained with the water stream (issuing from the nozzles) and forced into the delivery tube which delivers it into the tank against atmospheric pressure. In the tank the air separates from the water and is discharged from the top of it through the vent tapping, and water is retained in sufficient amount to maintain the required volume for operating the pump and exhauster. The surplus is automatically discharged to the boiler. When the water of condensation is being discharged to boiler there is no cessation or diminution of the exhausting action.

If no condensate is returning from the system no water is returned to the boiler. As condensation returns it accumulates in the tank raising the float, thereby operating its mechanism and opening the automatic discharge valve which permits its discharge to boiler under a 20 lb. effective pressure at the pump.

It is evident, therefore, that the pump may be relied upon to produce a vacuum and return the condensate, maintaining the proper boiler water line, at any boiler pressure which may obtain on a low pressure boiler conforming to the A.S.M.E. code. (The A.S.M.E. code specifies a safety valve setting of 15 lb. per sq. in.)



The Dunham Vacuum Pump

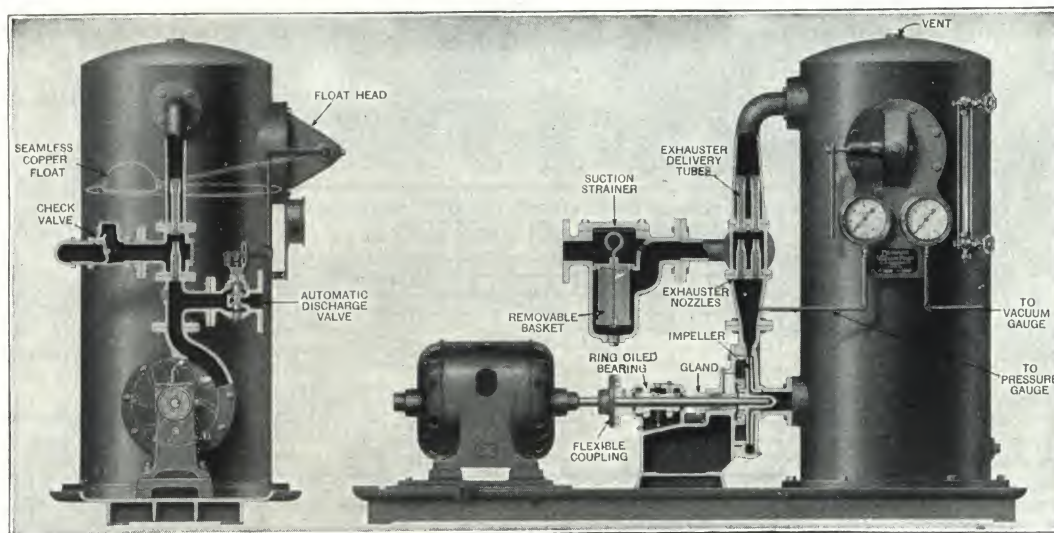


Fig. 1214A. Sectional Elevations of Dunham Vacuum Pump

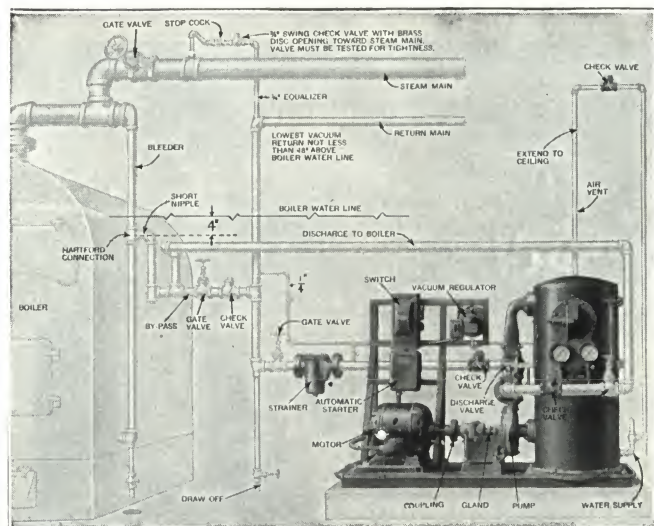


Fig. 1. Unit Completely Equipped with Automatic Vacuum Control

Piping connections made and ready for operation. Piping shown in gray tone is furnished by contractor. Suction strainer and check valves at inlet of pump, discharge of pump and in vent are furnished with unit, as well as companion flanges, bolts and gaskets

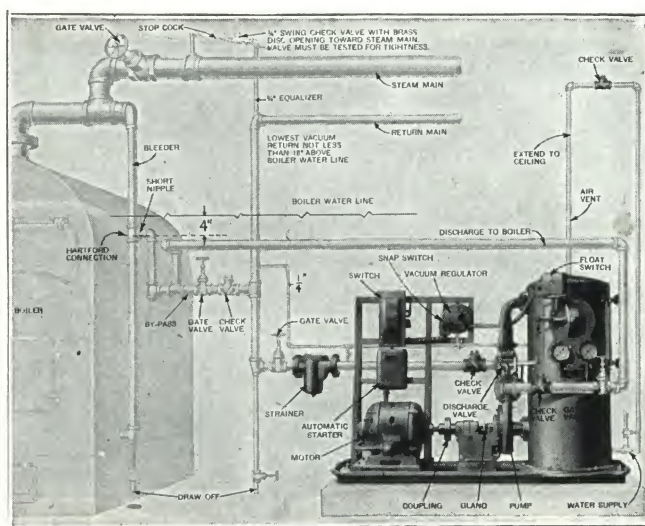


Fig. 2. Unit Equipped with Automatic Vacuum Control, also Float Control for Night Operation

Piping shown in gray tone is furnished by contractor. Suction strainer and check valves at inlet of pump, discharge of pump and in vent are furnished with unit as are companion flanges, bolts and gaskets

THE DUNHAM VACUUM PUMP (Continued)

The power consumed varies with the amount of condensate being handled, and with the pressure carried on the boiler. When little condensate is returning the power consumption decreases. Similarly when the boiler pressure is low the power consumption decreases, as shown by Fig. 715A.

The pump automatically responds to peak loads resulting from rapid condensation, such as occurs when the system is started up cold.

The Exhauster (Fig. 727B)—Operates on the principle of kinetic ejector utilizing the energy possessed by a stream of water in motion. By the use of a special nozzle of patented design the Dunham Exhauster operates over a wide range of temperatures because of controlled expansion within the nozzle. This expansive action prevents the vapor pressure of the water from flaring the stream which would result in the energy of the stream issuing from the nozzle being dissipated. The nozzle design also divides the stream of water so as to obtain great exposure to, and trapping of, the air and vapor to be exhausted, thus securing an exhausting action of high capacity and efficiency.

A distinctive feature of this jet principle lies in its ability to draw high degrees of vacuum. Under this condition condensable vapor volumes increase more rapidly than air. Thus vapors drawn into the water stream are condensed.

In addition to having these several characteristics, the exhauster has the advantage of no moving parts or close clearances to be maintained. Obviously, it will operate over a wide range of temperatures and its performance will be uniform over long periods of time and at little or no maintenance cost.

The Centrifugal Pump—Is bronze fitted including a non-corrosive shaft. The impeller is hydraulically and dynamically balanced, of high efficiency and is of the enclosed type. A volute type of casing is provided. Dust-proof, ring oiled bronze sleeve bearings of liberal size provide a construction which will operate for long periods of time with minimum attention, as has been demonstrated by experience. The pumps are driven by an electric motor direct connected through flexible couplings of special design.

The Receiving Tank—Is made of heavy rust-resisting steel. It is easily accessible for cleaning and is equipped with simple mechanism which operates the auto-

matic discharge valve. It is proportioned to effectively separate air from water and to insure certain priming of the pump and provision of ample hurling water to operate the exhauster. Power for operating the valve mechanism is supplied by a heavy seamless copper float located in the tank.

Pressure and Vacuum Gauges—For indicating conditions existing in the heating system are mounted on the tank.

The Automatic Discharge Valve—Is of special design embodying features which especially adapt it to the service. The materials it is constructed of are likewise selected so as to give long service. The valve seats are of special wear-resisting bronze. The valve is free to rotate with respect to the seat securing a grinding action. This reduces wear, keeping the valve tight. Recirculation is provided for this valve to insure against a loss of hurling water should foreign matter momentarily get between the valve and seat.

The body of the valve is of close grained cast iron of heavy section and is flanged to facilitate installation.

The Motors—The motors used are of the best standard manufacture. They are rated on 40 deg. temperature rise and provide ample margin of power.

The Control Equipment—Is mounted on the pump so as to make the unit complete. All electric wiring between the starter and motor is furnished. Each pump is given a complete test of several hours duration under its own control and power equipment before the unit leaves the plant. The control equipment provides against phase failure and gives overload protection for alternating current service.

After making the piping connections the installation is completed by connecting the line wires to the terminals of the safety disconnect switch, and in the case of installations Figs. 3 and 6 by the additional connection of float switch to the control cabinet.

Suction strainer and check valves for the suction and discharge connections with companion flanges are supplied with the pump.

The Base—Rigid and well braced, maintaining the proper alignment of the pump and motor. Leveling bosses and three point support are provided to reduce the work of installation. Base is also provided with tapping for piping drippings of oil or water to the sewer.

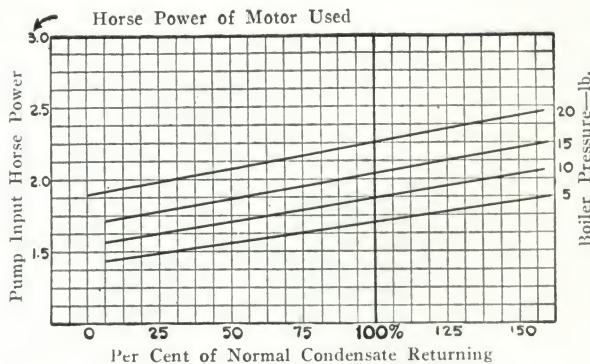
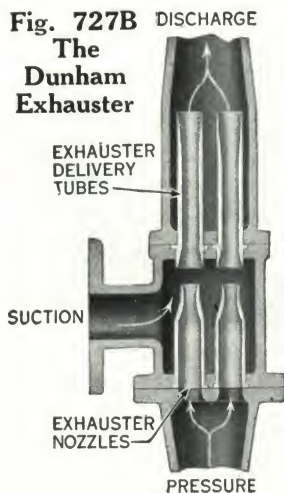


Fig. 715A

Power consumption curves for the V4A Dunham Vacuum Pump discharging to boiler against indicated boiler pressure

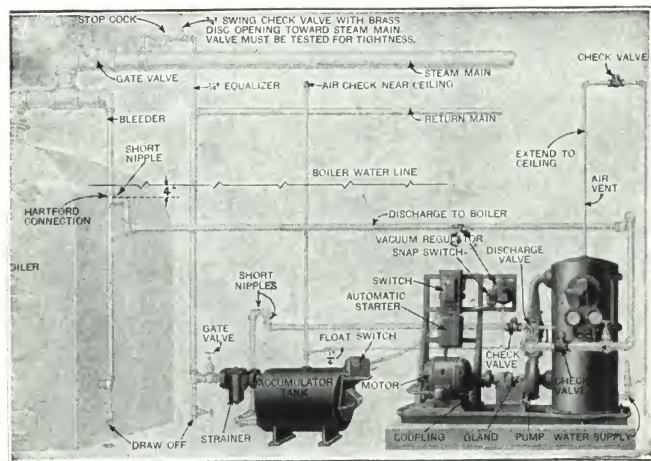


Fig. 3. Unit Equipped with Automatic Vacuum Control, also Accumulator Tank, with Float Control

Accumulator tank may be set on boiler room floor instead of in pit if returns come back at sufficiently high level. Piping shown in gray tone is furnished by contractor. Suction strainer and check valves at inlet to pump, discharge of pump and vent, as well as air check on vent of accumulator tank are furnished with unit, as are companion flanges, bolts and gaskets

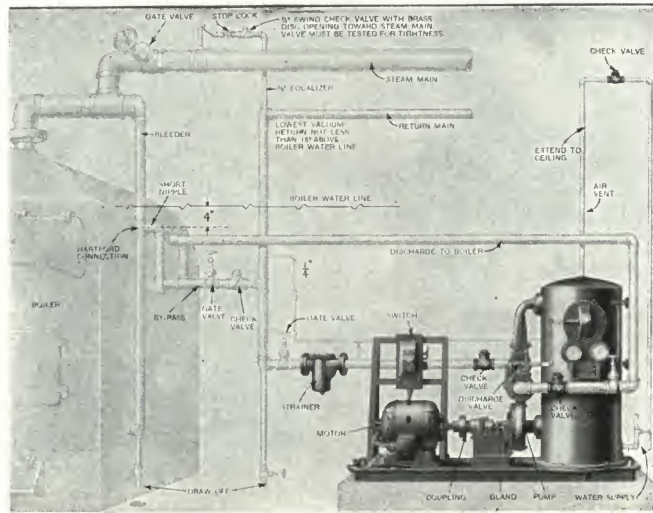


Fig. 4. Continuous Operation with Manual Controlled Switch

Piping shown in gray tone is furnished by contractor. Suction strainer and check valves at inlet of pump, discharge of pump and in vent are furnished with unit, as are companion flanges, bolts and gaskets

THE DUNHAM VACUUM PUMP (Continued)

Selection of a Pump

The selection of a vacuum pump divides itself into two items. (1) the selection of the size; (2) the selection of the control. Both depend largely upon the size of the system, the kind of heating load, and the nature of the building to be heated. The capacities of the various sizes of pumps are given in the table below.

Selection of the Control—The purpose a building is to serve, as well as its construction and arrangement, influences the arrangement of the pump and the control. For the convenience of the trade Dunham Pumps are provided in several standard types of control which are designated by figure number. The method of installing is co-ordinated with the control. The various arrangements provide flexibility, most efficient adaptation to the required service and greatest operating economy. The various installation and control arrangements are clearly shown in the illustrations which are self-descriptive.

Figure 1 (Dunham Page 52) Automatic Vacuum Controlled Unit—Provides means for maintaining the vacuum

within certain limits or a certain range. The unit finds its preferable application to installations where the return mains come to the pump at an elevation above the pump suction. It can also be used where condensate must be lifted to the pump. However, Fig. 3 is recommended where automatic control of the pump is desired and the condensate is to be lifted. Only vacuum control is provided on Figure 1 and is arranged to start the pump at approximately 3 in. and to stop it when approximately 7 in. of vacuum is reached. The vacuum switch is adjustable to secure other starting and stopping points.

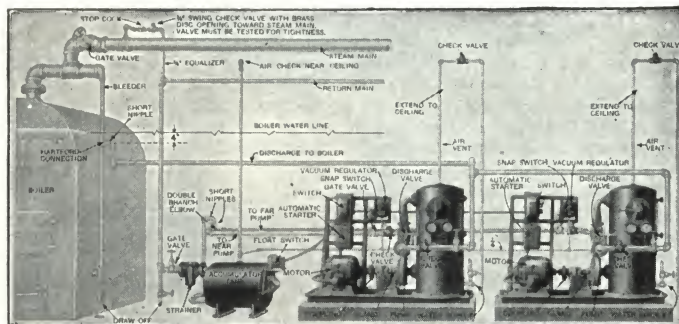
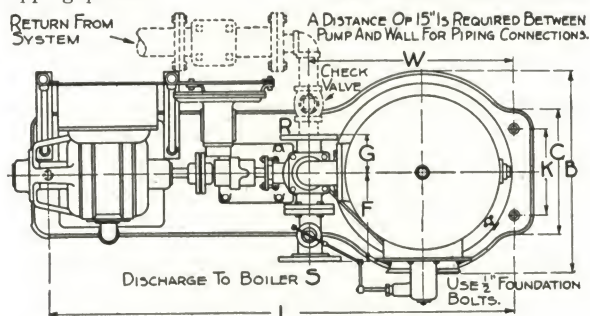


Fig. 6. Duplex Installation of Two Pumps, Each Equipped with Automatic Vacuum Control and Having Accumulator Tank with Float Control

Accumulator tank need not be placed in pit if returns come back at sufficiently high level. Piping shown in gray tone is furnished by contractor. Suction strainer and check valves at inlet to each pump, discharge of pumps and in air vents, as well as air check on vent of accumulator tank, are furnished with unit as are companion flanges, bolts and gaskets



ON INSTALLATIONS FIG 3 & 6 LOCATE STRAINER AT ACCUMULATOR TANK INLET.

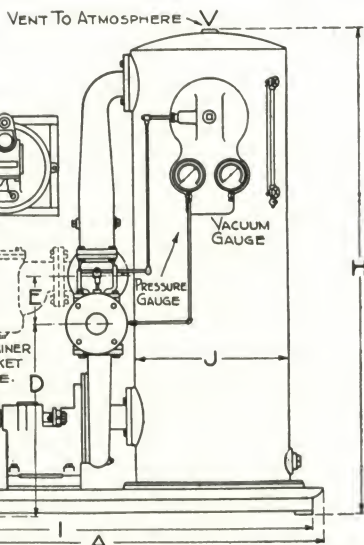


Fig. 1166A. Plan and Elevation Dunham Vacuum Pump

Figure 2 (Dunham Page 52), Automatic Vacuum and Float Control—When the radiation is installed at a level well above the top of the tank on pump unit, so that water of condensation gravitates into it, the unit can be furnished with a float control mounted on the tank in addition to the vacuum control. With this float control the pump can be operated at night as an automatic condensation pump by turning the snap switch (installed between the vacuum regulator and starter), thus cutting out the vacuum control but leaving the float switch in service. In other words when vacuum is desired on the heating system vacuum control is in service as quick circulation is necessary, but when vacuum is not desired the float control alone is operative.

Figure 3 (Dunham Page 53) Automatic Vacuum and Float Control with Accumulator Tank—This unit supplies both automatic float and vacuum control and is most flexible in its adaptability to various installations. Return mains coming back at elevations below or above the boiler water line or pump suction can be easily cared for. The accumulator tank is always installed at a sufficiently low level so that the condensate may gravitate into it.

The accumulator tank is equipped with a float switch control wired to operate in conjunction with the vacuum control. A snap switch is provided so that the vacuum switch may be thrown out of operation whenever desired and the unit permitted to operate under float control only.

Condensate from the heating system enters the accumulator tank by gravity. The air flows into the tank from which it and the condensate also is withdrawn by the vacuum pump. Should the accumulator tank fill with water, the pump is started by the float control. This insures the return of the water of condensation at all times.

TABLE OF CAPACITIES AND DIMENSIONS

See Fig. 1166A
Standard Vacuum Pumps

No.	V0A	V1A	V2A	V3A	V4A	V5A	V6A
Rated sq. ft. rad.	5000	8000	16000	26000	40000	65000	100000
Kind of electric current	Any current	Any current	Single phase 2 or 3 phase or direct current	2 or 3 phase or direct current	Single phase 2 or 3 ph., 50 or 60 cy., or d.c.	2 or 3 ph., 25 cy. single ph. or 550 d.c.	Any current
H.P.	3/4	1	1 1/2	2	3	5	7 1/2
A	57 3/8	60 3/8	63 3/8	60 3/8	63 3/8	66 3/8	81 1/4
B	21	24	24	24	24	26	30
C	14 1/8	15	18 1/2	15	18 1/2	19 3/4	22
D	19 1/8	21 1/4	21 1/8	21 1/8	22 3/4	23 1/4	25 1/8
E	47 1/8	5 1/8	4 1/8	4 1/8	5 1/8	5 1/8	5 1/8
F	8 1/8	8 1/8	8 1/8	9 1/8	10 1/8	10 1/8	14 3/8
G	3 1/4	3 1/4	3 1/4	4	4 1/2	5 1/8	6
H	37 3/4	46	46	52	58	58 1/2	62 1/2
I	55	57 3/4	61 3/4	57 3/4	61 3/4	64 3/4	79
J	15	18	18	18	18	20	24
K	10 1/4	10 3/4	14 1/8	10 3/4	14 1/8	15 1/4	17
L	52 1/2	55 3/4	59	55 3/4	59	62	76 1/4
R	1 1/2	1 1/2	1 1/2	2	2 1/2	3	5
S	1 1/4	1 1/2	2	2 1/2	3	3	3 1/2
V	1	1	1	1	1 1/2	1 1/2	1 1/2
W	22 3/4	25 1/8	25 1/8	25 1/8	25 1/8	26 1/8	34 3/8

Note: The above dimensions are general. For actual installation request certified print for location of base bolts.

Material furnished with Pump:

Strainer with Companion Flanges, Bolts and Gaskets.

Companion Flanges, Bolts and Gaskets for Return and Discharge Connections of Pump.

Swing Check Valve between Strainer and Pump.

Swing Check Valve for Discharge to Boiler

Swing Check Valve for Pump Vent.

Dunham Air Check for Vent from Accumulator Tank with Figure 3 and 6 installations.

DUNHAM VACUUM PUMP (Continued)

If vacuum control is in service a vacuum will be maintained on the system and the pump started and stopped at intervals. During the time that the pump is out of operation, due to vacuums obtaining after cut out point of vacuum switch is reached, condensate will accumulate in the tank at the rate it is forming in the system and be returned to the boiler by the pump in response to its operation by the float switch.

Figure 4, Continuous Operating Unit—The continuously operating unit is a logical one where the total load is blast radiation or where the preponderance of the load is blast radiation. It is likewise a most logical selection where there are lifts some distance from the

pump. The presence of such lifts makes it advisable to maintain a high vacuum at all times.

Figure 6, Duplex Installations—On large jobs, good engineering practice is to provide duplicate pump installation. Preferably each pump should be connected so as to operate independently of each other or together. A most satisfactory arrangement for an automatic float and vacuum controlled unit is provided in the Figure 6 installation. In operation it is the same as the Figure 3 control, both pumps being operable in conjunction, or either unit may be operated independently of the other. The pumps may be installed with either the short or long sides parallel to one another, or as may be necessary in view of the available space.

Installation Suggestions

In every case we recommend that the pump itself be set level on a suitable concrete foundation and well grouted, having its top 3 to 6 in. above the boiler room floor rather than in a pit.

If one return line comes back to the pump at a lower level than the suction connection to pump and an accumulator tank is not used it is recommended that all returns be connected to the pump through the same lift fitting. Figures 957A and 879, Dunham page 47. The advantage of this method is that suction will be produced on all returns with same intensity.

Frequently, by giving careful study of the run of piping, the heating system can be so designed that the apparent need of a lift fitting will disappear.

Avoid lift connections in return mains, except right at the vacuum pump, and if needed at this point, arrange it so that all the returns pass through the one lift connection.

Lift connections should not exceed 6 ft. in height. Preferably they should be less than this. If necessary to lift vertically a greater distance than 6 ft. use several lift connections connected in step formation.

The tank accumulator must be the low point of the system, with returns grading toward and into the inlet of tank. Wherever possible the accumulator tank should be installed so that its outlet tapping is slightly above the pump section, that is, so the condensate can flow by gravity from the accumulator tank to the pump. Where this is not possible the tank should be placed as high as possible so as to keep the lift at a minimum. It requires approximately 1 in. of vacuum for each foot of lift. By keeping the lift at a minimum the amount of vacuum used to lift the water is also kept to a minimum with a higher vacuum available for the system.

With the pump operating, the accumulator tank will be fairly free from water. The pump will then lift slugs of water between slugs of air, as the water makes and breaks the seal at the tank outlet. By using the lift connection half way up, in cases where the lift is greater than 6 ft., the vacuum neces-

sary to lift the water into pump is reduced one-half. That is, if there was 8 ft. lift from accumulator tank outlet to pump suction with the lift connection midway it would take only 4 in. to make the lift instead of 8 if the lift connection was omitted.

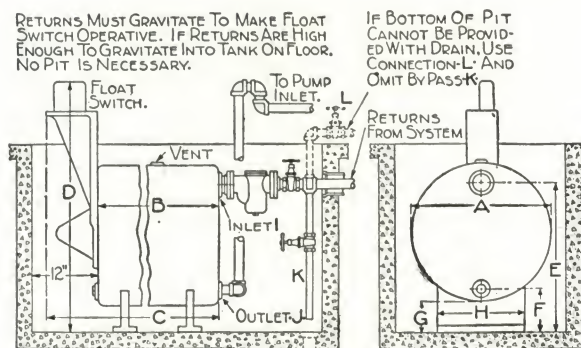


Fig. 1167. Roughing-in Dimensions, Accumulator Tank

Size vacuum pump	Size of tank, in.	Dimensions in inches								Size strainer, in.	Pipe connections, in.		Size of pit required
		A	B	C	D	E	F	G	H		Inlet I	Outlet J	
VOA & V1A	18x18	18	18	27	33	15½	5½	3½	12	2	2	1½	3'6"x5'0"
V2A & V3A	18x24	18	24	33	33	15½	5½	3½	12	3	3	2	3'6"x5'6"
V4A & V5A	18x36	18	36	45	33	15½	5½	3½	12	4	4	3	3'6"x6'8"
V6A	24x48	24	48	57	36	24	6	3	18	5	5	4	4'0"x7'8"

Typical Specifications

Furnish and install one Dunham Vacuum Pump, size, having a rated capacity of sq. ft. of direct radiation and built for *20-lb. pressure at the pump. Motor furnished shall be of 40° ratings, of not greater than horsepower, and shall be wound for current available.

This unit shall consist of a welded steel tank; a bronze-fitted enclosed impeller pump with non-corrosive metal shaft, and motor, all mounted on substantial cast-iron base of the coping type, with exhaust, automatic discharge valve, pressure and vacuum gauges, water gauge glass and necessary accessories and electrical controls. It shall be installed and connected where shown on plans in accordance with manufacturer's instructions.

Base of pump shall be grouted in foundation and securely anchored with ½-in. bolts. In the suction line of pump install a gate valve, suction strainer and swing check valve, also install valved by-pass to sewer. In the discharge line to boiler install a swing check valve and gate valve, placing the check valve between pump and gate valve. Vent from tank shall be run full size of tapping to a level near ceiling of boiler room and then brought down to near floor level. Install check valve in this vent pipe.

Note: The foregoing is suggested as standard specification for continuous operation pumps, also for all specifications for automatic control regardless of type of control wanted. Sections A, B, C, to be added according to control required. Thus:

Automatic Vacuum Control—Typical Specifications and Section "A."

*Unit VOA is built for 18-pressure at pump. Larger units are built for 20-lb. pressure at pump.

Automatic Vacuum and Float Control—Typical Specifications and Sections "A" and "B."

Automatic Vacuum Control with Float Control on Accumulator Tank—Typical Specifications and Sections "A" and "C."

(A) Automatic Vacuum Control (Equipment shown in Unit Figure One)—In connection with the vacuum pump there shall be furnished automatic vacuum regulator which shall maintain a range in vacuum in the return lines of heating system. This equipment to be furnished with pump and mounted on a frame bolted to base of pump and shall include an enclosed safety knife switch.

(B) Automatic Vacuum and Float Control (Equipment shown in Unit Figure Two)—A float switch shall be furnished, mounted on the air separating tank and wired so that the vacuum regulator can be cut out and the pump operated as a condensation pump and receiver when so desired. This float switch and the automatic vacuum regulator and switches are to be arranged and wired so that the vacuum regulator can be put out of service by turning a snap switch, permitting the float control alone to operate the pump.

(C) Automatic Vacuum Regulator with Float Control on Accumulator Tank (Equipment shown in Unit Figure Three)—Below the low point of return lines install an accumulator tank, size, equipped with float switch. All returns are to gravitate into this tank through the suction strainer and be connected to top connection on tank. From the bottom connection of tank make pipe connection to the suction of vacuum pump, which shall be set up on the boiler room floor. The float switch and the automatic vacuum regulator and switches are to be arranged and wired so that the vacuum regulator can be put out of service by turning a snap switch, permitting the float control alone to operate the pump.

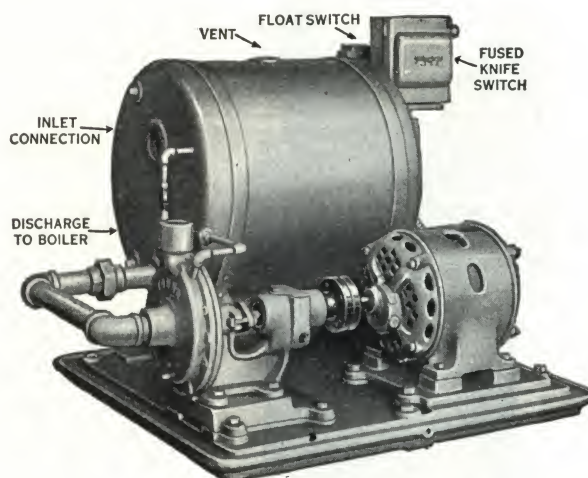
DUNHAM CONDENSATION PUMP AND RECEIVER (Horizontal Type)

Frequently it is necessary to lift condensate automatically. This pump provides an efficient, reliable and inexpensive equipment for this purpose, avoiding the need of special building arrangements such as boiler pits, etc. The radiation may be installed on the *same level as the boiler*.

The data below covers only the horizontal type condensation pump. A vertical type is described on Dunham page 57.

Outstanding Features

- (1) Small first cost.
- (2) Low operating cost.
- (3) Positive removal of condensate from system and return at intervals to boiler.



- (4) Acceleration of heating the building through improved circulation.

Construction

The pump is volute case, bronze fitted, including a non-corrosive shaft. The impeller is hydraulically and dynamically balanced, of high efficiency and is the enclosed type. Dustproof ring oiled, bronze sleeve bearings of liberal size provide a construction which will operate over long periods of time with minimum attention. The pump is driven by an electric motor direct-connected through flexible couplings of special design. It is a completely assembled unit ready for piping and wiring connections, including knife switch with fuse.

The pump will discharge against the listed pressure at the pump. We show a typical connection (Fig. 874C). If the boiler is on a higher level, or some distance away from the pump, care should be exercised to select a pump of sufficient pressure to more than equal boiler pressure plus height of discharge pipe plus friction in discharge pipe.

Example: Safety valve set for 15 lb., 8000 sq. ft. radiation, a pump of this capacity will discharge 16 g.p.m. Pump pit 10 ft. below boiler water line.

5—1¼-in. ells (check and gate valve considered equivalent to 2 ells). Length of pipe between pump and boiler..... 20 ft.
Friction in straight pipe for 5—1¼-in. ells = 40 ft.

Total length..... 60 ft.

Friction = $4.65 \times 0.6 \times 0.433 = 1.2$ lbs.

Boiler pressure = 15.0

Elevation = $10 \times .433 = 4.3$

20.5 Use 20 lb.* pump.

*Velocity head neglected

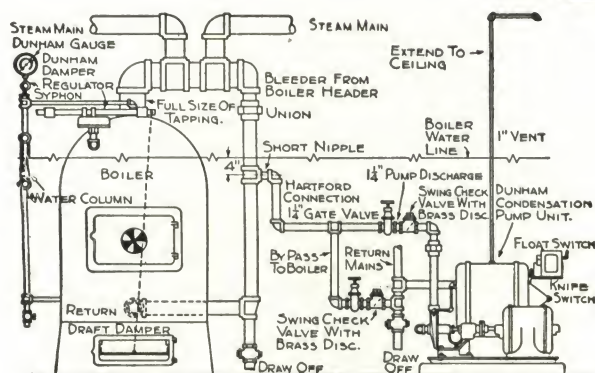


Fig. 874C. Dunham Condensation Pump Connection

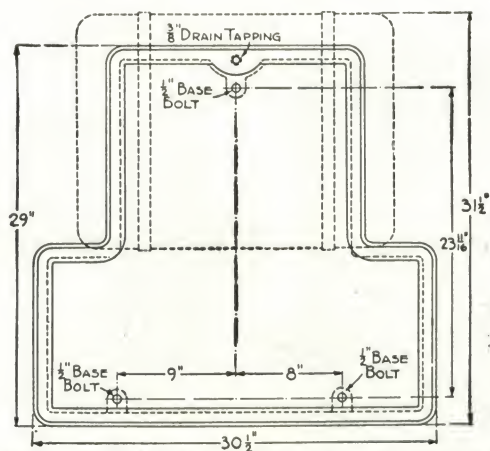
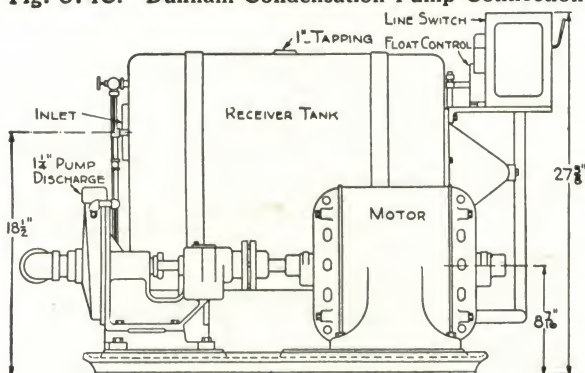


Fig. 1210. Over-all and Setting Dimensions, Dunham Condensation Pump and Receiver

10-LB. CONDENSATION PUMPS

Unit No.	Maximum square feet of direct radiation	Horse power of motor	Capacity, gal. p. m.	Inlet connection	Discharge connection	Size of receiver	Capacity of receiver	Gal. p. m. radiation will condense	Approximate floor space	Type and size of pump	Distance from bottom of base to inlet connection	Approximate shipping weight, lbs.
210A	2,000	1/2	4 2	1 1/4	18x18	20	1	32x38	3/4" BA	18 1/2"	440	
410A	4,000	8/2	8 2	1 1/4	18x18	20	2	32x38	3/4" BA	18 1/2"	440	
610A	6,000	12 2	12 2	1 1/4	18x18	20	3	32x38	3/4" BA	18 1/2"	440	
810A	8,000	16 3	16 3	1 1/4	18x24	26	4	32x41	1" BA	18 1/2"	470	
1010A	10,000	20 3	20 3	1 1/4	18x24	26	5	32x41	1" BA	18 1/2"	470	
1510A	15,000	30 3 1/2	30 3 1/2	1 1/4	18x36	40	7.5	32x47	1 1/2" SA	18 1/2"	540	
2010A	20,000	1	40 3 1/2	1 1/4	18x36	40	10	32x47	1 1/2" SA	18 1/2"	580	
2510A	25,000	1	50 3 1/2	1 1/4	18x36	40	12.5	32x47	1 1/2" SA	18 1/2"	580	

20-LB. CONDENSATION PUMPS

220A	2,000	$\frac{3}{4}$	4 2	$1\frac{1}{4}$	18x18	20	1	32x38	$\frac{3}{4}$ " BA	18 $\frac{1}{2}$ "	440
420A	4,000	$\frac{3}{4}$	8 2	$1\frac{1}{4}$	18x18	20	2	32x38	$\frac{3}{4}$ " BA	18 $\frac{1}{2}$ "	440
620A	6,000	$\frac{3}{4}$	12 2	$1\frac{1}{4}$	18x18	20	3	32x38	$\frac{3}{4}$ " BA	18 $\frac{1}{2}$ "	440
820A	8,000	$\frac{3}{4}$	16 3	$1\frac{1}{4}$	18x24	26	4	32x41	$\frac{3}{4}$ " BA	18 $\frac{1}{2}$ "	440
1020A	10,000	1	20 3	$1\frac{1}{4}$	18x24	26	5	32x41	1" SA	18 $\frac{1}{2}$ "	470
1520A	15,000	1	30 3	$1\frac{1}{4}$	18x36	40	7.5	32x47	1" SA	18 $\frac{1}{2}$ "	540
2020A	20,000	$1\frac{1}{2}$	40 $3\frac{1}{2}$	$1\frac{1}{4}$	18x36	40	10	32x47	1" SA	18 $\frac{1}{2}$ "	610
2520A	25,000	$1\frac{1}{2}$	50 $3\frac{1}{2}$	$1\frac{1}{4}$	18x36	40	12.5	32x47	1" SA	18 $\frac{1}{2}$ "	610

35-LB. CONDENSATION PUMPS

235A	2,000	2	4 2	1 1/4	18x18	20	1	32x44	1\"/>
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50-LB. CONDENSATION PUMPS

250A	2,000	3	4 2	1 1/4	18x18	20	1	32x44	1\"/>
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DUNHAM CONDENSATION PUMP AND RECEIVER (Vertical Type)

This pump is designed to handle condensate on installations where the return mains come back at, or below, the boiler room floor, discharging it automatically direct to the low pressure heating boiler. Typical connections are shown by Fig. 1240.

The use of this pump permits radiation to be placed on the same level as the boiler without the need of special building arrangements such as boiler pits, etc. This makes possible use of space that would otherwise be wasted.

The pump being submerged in the condensate, or return water, is self-priming and immediately when the float switch cuts in, the pump will discharge the water to the boiler until the desired level is reached and float switch stops the pump. The simplicity and reliability of this unit recommends it for water of any temperature.

Stuffing glands at the motor shaft and float rod prevent vapor from rising into the motor and electric switches.

The thrust of the pump is carried by ball thrust bearings, lubrication being easily accomplished with minimum of attention.

A cast iron strainer of ample area is provided at the pump suction to exclude foreign matter from the pump.



Dunham Vertical Condensation Pump

It is a completely assembled unit ready for piping and wiring connections; even knife switch², with proper fuses are included. See Fig. 1241.

10 POUNDS PRESSURE AT PUMP

Type No.	Cap. sq. ft. radiation	H. P. of motor	Capacity G. P. M.	Inlet conn.	Disch. conn.	Size of rec. (A & B)	Diam. of cover plate (C)	Ht. above floor (D)	From top of tank to center inlet (E)	Approx. ship. wt.
700	2000	1½	4	2	1½	24x30	28"	20"	12"	1050
701	4000	2½	8	2	1½	24x30	28"	20"	12"	1050
702	6000	3½	12	2	1½	24x40	28"	20"	18"	1225
703	8000	4½	16	3	1½	24x40	28"	20"	18"	1225
704	10000	5½	20	3	1½	24x48	28"	20"	18"	1350
705	15000	7½	30	3½	1½	24x48	28"	20"	18"	1350

20 POUNDS PRESSURE AT PUMP

Type No.	Cap. sq. ft. radiation	H. P. of motor	Capacity G. P. M.	Inlet conn.	Disch. conn.	Size of rec. (A & B)	Diam. of cover plate (C)	Ht. above floor (D)	From top of tank to center inlet (E)	Approx. ship. wt.
708	2000	2½	4	2	1½	24x30	28"	20"	12"	1050
709	4000	4	8	2	1½	24x30	28"	20"	12"	1050
710	6000	6	12	2	1½	24x40	28"	20"	18"	1225
711	8000	8	16	3	1½	24x40	28"	20"	18"	1225
712	10000	10	20	3	1½	24x48	28"	20"	18"	1350
713	15000	15	30	3½	1½	24x48	28"	20"	18"	1350

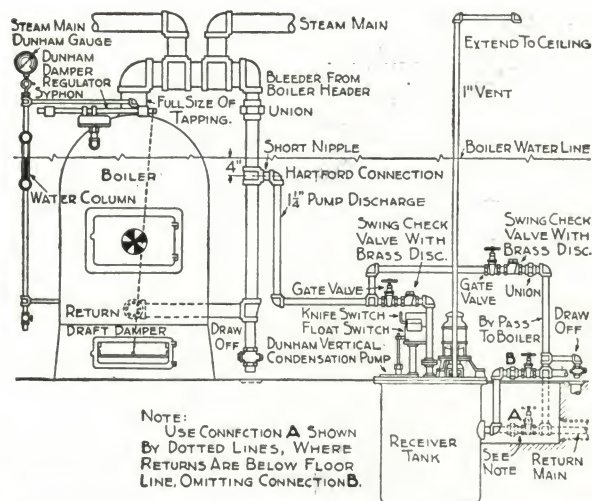
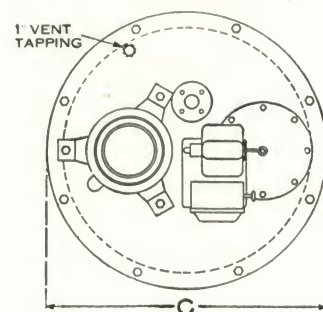


Fig. 1240. Typical Connections, Vertical Type Condensation Pump

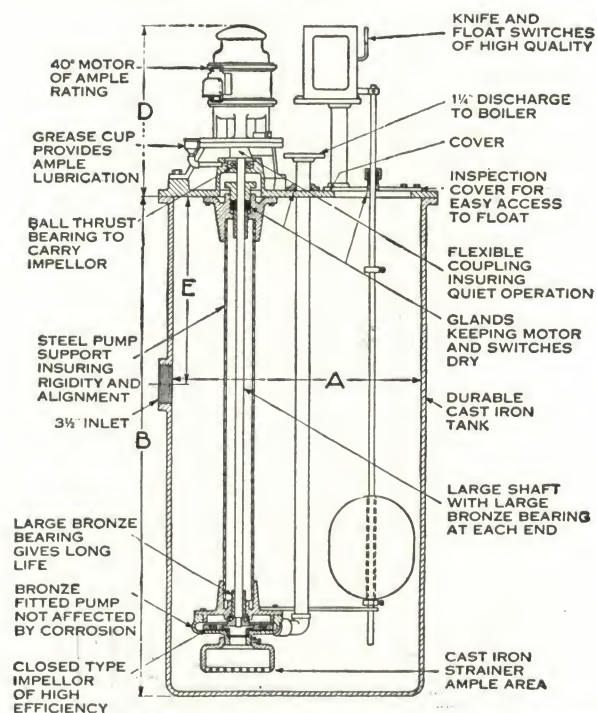


Fig. 1241. Sectional Drawing, Vertical Type Condensation Pump

DWYER VOLUME TYPE UNIT HEATERS

A Type and Size for Every Requirement

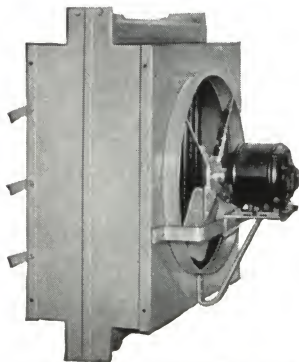
Type "V," Floor and Suspended Types

A simple, compact design in the smaller sizes. The fan is made entirely of aluminum, is mounted direct on the motor shaft. Cold air enters direct the back of the unit and is forced over the radiator by the fan. Separately adjustable louvres are provided at the discharge to deflect the heated air up or down as desired.

Particularly well adapted to retail stores, offices, automobile show rooms, etc. Also used extensively in small factories and public garages. The suspended type can be hung direct from the steam main line from the ceiling with band-iron hangers, or from the wall with wall brackets. The floor type unit takes up very little floor space. The floor stand is only large enough in area to admit air to the unit proper.



Type "V" Floor Type



Type "V" Suspended Type

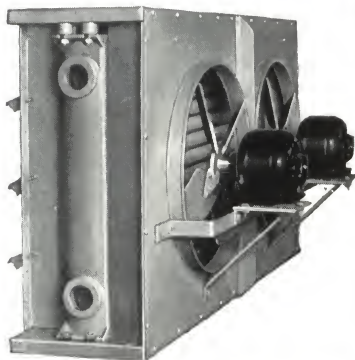
Type "D" Dwyer Unit

Much the same as the Type "V" in general design, but is available in much greater capacity. The essential difference is that although the Type "D" has only one radiator, it is equipped with two fans and two motors. It is really two Type "V" units in one.

The motors can be connected so that both are operated from one switch or they can be connected to separate switches for operation independently of each other. This makes the installation much more flexible. With only one motor in operation, the capacity of the unit is approximately 60% of the full rated capacity.

A simple, compact design, easily and inexpensively installed. The larger size requires only one steam supply and one return connection.

These heaters are usually installed in a horizontal position as pictured below. They can be used in a vertical position, which is sometimes desirable because of space limitations—as for instance—on narrow pilasters between windows.



Type "D" Suspended Type



Type "D" Floor Type

Type "F" Dwyer Unit

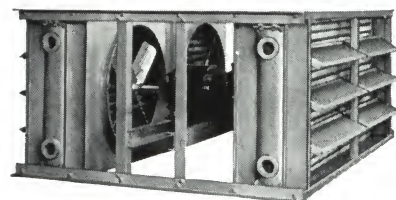
An exceptionally compact heater in the larger sizes. It is equipped with two motors and four fans—one fan mounted on each end of the motor shaft.

Like the Type "D", motors can be independently operated.

The unit delivers approximately 60% of its full capacity with one motor in operation.

The heated air is discharged in opposite directions through adjustable louvres which control the direction of the air stream.

The unit can be installed in the center of a large room or against the wall of the building discharging along the wall.



Type F

This type unit is regularly furnished in suspended type but can easily be fitted with floor supports if required.

This type of unit is particularly adapted to large multi-story industrial plants for ceiling suspension. The largest size (equal to approximately 4000 sq. ft. of direct radiation) is only 30 inches in height.

The unit can be installed tight against the ceiling of the building.

Radiators for Special Application

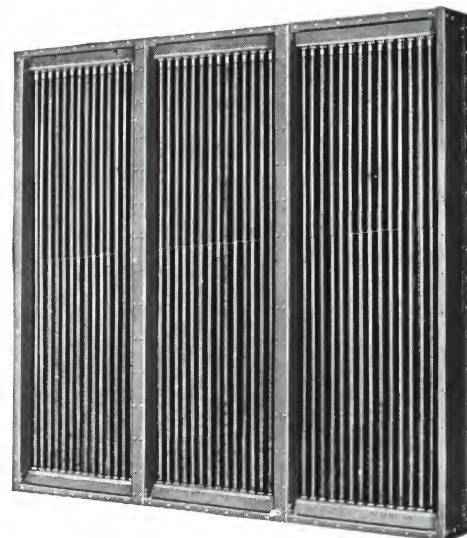
There are many industrial processes which involve heating or cooling of air. In many instances, Dwyer Unit Heaters can be used for this purpose. There are cases, however, where the temperature rise must be greater or less than that obtained from a standard Dwyer Heater—or where resistance to the flow of air is too great for the fan in the standard heater. For these applications, we offer the Dwyer Radiator housed in a sheet metal casing, to which sheet metal air ducts may be attached and which may be used in conjunction with any type or size of fan or blower.



Built in units, each exactly the same width and depth. Only variation is in the height. This makes it possible to assemble any required number of units of the same height in any required number of units wide and deep.

Every size radiator unit is available with one, two, or three rows of tubes. This makes possible an assembly in multiples of one row of tubes deep.

Radiators are usually installed with tubes vertical. They can be arranged for installation with tubes in horizontal position when necessary.



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